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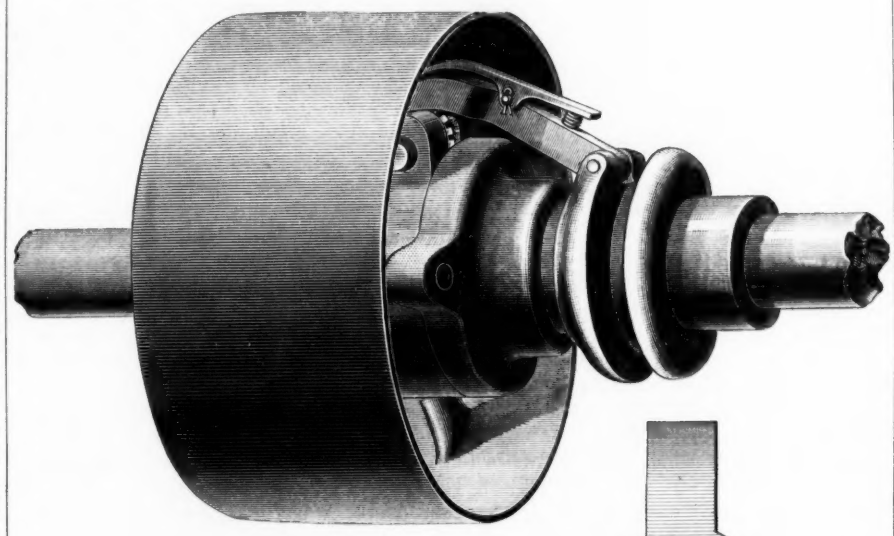
New Pulley Clutch and Cut-off Coupling.

The pulley clutch of which we give illustrations, showing it in whole and in detail, consists of a very few parts, simple in construction and compact in arrangement. Fig. 1 shows an end view, and Fig. 2 a longitudinal section of the clutch. The long hub *I* cast to the pulley is bored out and lined with a brass bushing *J*. This pulley runs loosely on the shaft, and the long hub of the flanged coupling *H* is keyed on the shaft. The hub of this coupling is turned off to allow the sleeve *G* to move longitudinally on it. Fig. 3 shows a separate view of one of the clamps *A A*, shown in Fig. 2; each clamp is pivoted on a bolt *M*; these bolts are fitted into the flange of the coupling *H*, so as to cause the clamps to revolve with the coupling. For further security a plate *N* is placed under the heads of the bolts *M M* to tie the two together. The right and left-handed screw *C C* works in brass nuts, which are fitted in the clamps *A A*, and by turning this screw in one or the other direction the clamps *A A* are either tightened or loosened on the hub *I* of the pulley. For the purpose of turning the screw *C C* in either direction a ratchet wheel is fastened to its center, which engages with the pawl *D*; the pin, on which this pawl works, passes through two links *O O*, which are free to rotate on the screw *C C*; this pin also passes through the forked end of the lever *F*, which is shown separately in Fig. 4. The other end of this lever is attached to the sleeve *G* as shown. From the foregoing it will be seen that the links *O O* form a connection between the screw *C C*, the ratchet wheel, pawl, and the lever *F*. A finger *E* is fulcrumed on the back of the lever *F*, and the spring 1, acting at one end, causes the other end of the finger to press on the pawl *D*, keeping the latter engaged with the wheel. Now, by means of a suitable fork and collar in the groove of the sleeve *G*, a longitudinal movement can be given to the sleeve while the shaft is in motion. When the movement of *G* is towards the pulley, the lever *F* is carried forward, and the pawl and ratchet act to tighten the clamps *A A*, thereby transmitting motion to the pulley; when a loosening of the clamps is required the sleeve *G* is moved back sufficiently to reverse the pawl *D*; the finger *E* in this case will bear on the other side of the pawl, causing the ratchet wheel to loosen the screws. This at first sight may seem to be improbable, but it will be found on investigation that, as the lever *F* recedes the position of the pawl *D* relatively to the lever *F* changes, and when a certain distance has been passed over, the finger *E* has ridden over the outer edge of the pawl *D*, and the pressure is applied to the side of the pawl opposite to that shown in the illustration. By this simple means the position of the pawl is quickly changed, thereby producing an action either for tightening or loosening the screw *C C*, according to which side of the pawl is engaged with the ratchet wheel, the whole arrangement requiring but a small space on the shaft. A marked advantage is claimed for this clutch, namely, the tightening may be gradual, thereby starting the machinery slowly, and by further tightening, all slipping on the pulley is prevented. For dynamos, and other machinery requiring caution in starting, this clutch is said to be well adapted.

For cut-off couplings the pulley part is not required; one section of the shaft extends into the hub *I* sufficiently far to support it while running loose, and the hub *I* is keyed on the other section of the shaft.



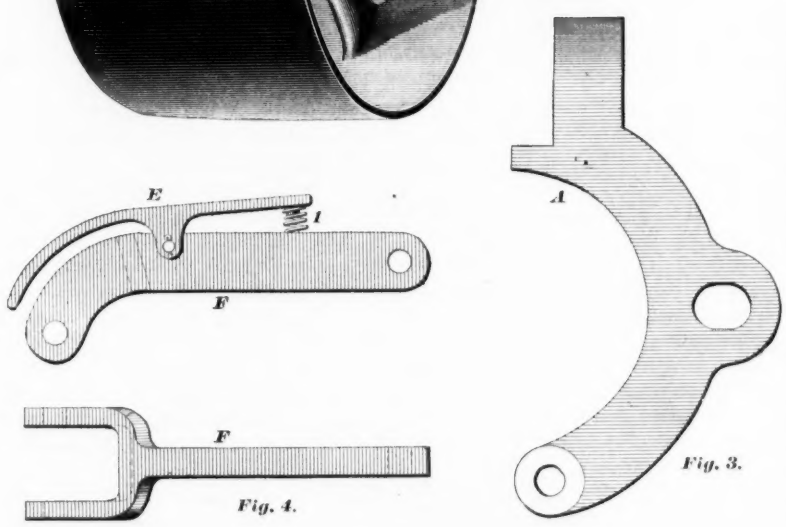


Fig. 3.

Fig. 4.

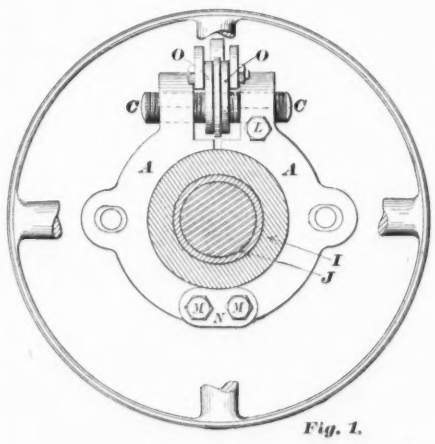


Fig. 1.

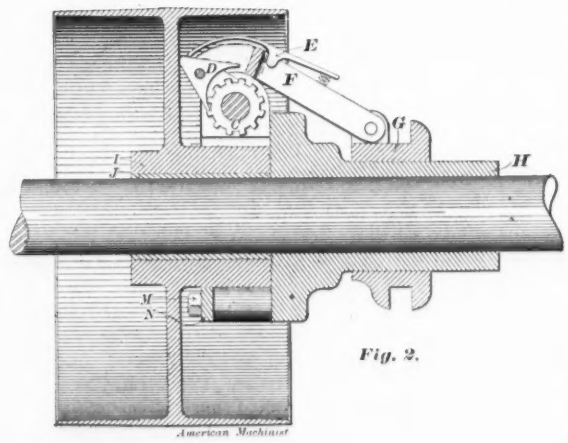


Fig. 2.

PULLEY CLUTCH AND CUT-OFF COUPLING.

At *L* a screw is provided when soft metal or a wooden plug is to be brought in contact with screw *C*. By tightening the screw *L* the plug is brought in contact with *C*, and makes it tighter in the thread, so as to stand without loosening when in use.

This pulley and cut-off coupling is manufactured by the Allentown Foundry and Machine Co., of Allentown, Pa., under the patent of W. J. Woodcock, Auburn, N. Y.

The "Majestic's" record is not beaten yet.

The place that the newspaper of to-day has taken as an educator can hardly be overestimated. One cannot shun books and expect to know much, but particularly he cannot let the papers go by him and hope to keep anywhere abreast of the day. In all that is done to civilize mankind nothing ranks with the printing press. And yet there is hardly a machine made about which less is said.

In accordance with the recommendation of Board of Ordnance and Fortification, the contract for 100 breech-loading guns—built up forged steel—is given to the Bethlehem Iron Company, of South Bethlehem, Pa. The cost will be a little less than four million dollars.

Now the Millers' League has combined against the farmers who propose to hold their wheat for better prices. So one thing balances another.

Steam Engine Fly Wheels.

BY PROFESSOR JOSEPH TORREY.

SECOND PAPER.

There is no formula for proportioning fly wheels to secure steadiness of motion which will apply to all cases. Such formulas are, nevertheless, found in almost all "engineer's pocket-books." Most of them contain the "horse-power" as one factor and usually the length of stroke among other things. Such formulas can only be of service when for one single machine they have been tested, and empirical constants inserted. Even then it happens quite commonly that engine builders find that, when they introduce new sizes, the formula refuses to give a good weight in the fly wheel rim. In fact, this is what may be expected as long as an attempt is made to use formulas which do not rest on fundamental principles. In short, the design of fly wheels is a matter for careful study and judicious engineering in every case of departure from standard types already provided for. Of course it would be possible to design a wheel which would be heavy enough, and too heavy, in any case, without much real thought on the subject, but that is not engineering. There is much more involved in these days than simply securing a weight that will solve the equalization problem. Cast-iron is too expensive to waste. The difficulty of making the casting increases too rapidly with increased weight, and last, but not least, it is exceedingly important that unnecessary weight on the main journals should be avoided. Therefore, let us approach the question as a most interesting and important problem in engineering, and formulate it as follows:

To design a fly wheel which, for a given engine or type of engine, shall give steady motion, with the least amount of metal, at a given speed.

The first step in the solution of this problem will be to study the case in detail, to see just what is the source of unsteady motion, how the amount of unsteadiness in a given case can be determined, and to give a simple graphic method by which any engineer can, in a very short time, analyze the action of any given combination of speed, weight of parts, and ratio of expansion.

It has been conclusively proved that the effort on the crank-pin is never the same as that of the steam on the piston—that is, the diagram traced by the indicator, and the diagram of effort on the crank-pin, as modified by inertia, will always differ in their outline, and the difference between them will be the more marked as the ratio of expansion increases and inertia increases. This may, I think, be considered a postulate. While there may be a few engineers in these times who dispute the conclusions of theoretical mechanics on this point, it is hardly possible that the testimony of the Williams inertia instrument, and later, that of the "inertia indicator" constructed by the writer, should be discredited. These show conclusively the modifying effect of inertia on the distribution of force throughout the stroke.

But again: The diagram of effort on the

crank-pin does not give a true account of the *rotative effect;* that is, it does not show how this power is exerted round the circle of crank rotation at each point in the stroke. It is evident that this will depend on the angle at which the force is applied.

Now this diagram of rotative effect is the one thing we are concerned with in our fly wheel problem, and the first thing to be done in any case is to construct this diagram.

In a former series of papers the necessary rules and tables have been given by which we construct the diagram of effort along the connecting rod on the crank-pin.

Now if the diagram of effort on the crank-pin be divided into ten equal parts by perpendicular lines, then the amount of rotative effect at each of these lines can be found by multiplying the effort on the crank-pin by the corresponding decimal in the following table:

BACK END.	
0	0.000
1	0.64
2	0.845
3	0.940
4	0.995
5	0.997
6	0.955
7	0.881
8	0.750
9	0.560
10	0.000

FRONT END.

To illustrate: Let us consider the diagram shown in Fig. 1, a most excellent one to start with, since the steam diagram was drawn by the indicator, and the inertia curve by the Williams inertia instrument.

In this diagram we have represented the steam diagram *a a a a*, the inertia curve *i i*, which, in the absence of the inertia instrument, must be plotted, using the method given in papers by the writer in the AMERICAN MACHINIST of 1888 and 1889.

Taking, now, the diagram with the steam and inertia curves, and plotting in the line *o o*, which represents the neutralizing action of compression on inertia, we get the area *o o i a*, which is the diagram of effort on the crank-pin. Next transfer this diagram to the base line *o d*, and we obtain the diagram *o c c c c*. The height of any point in this curved line *o c c c*, measured with a scale of pounds, represents the pressure on the crank-pin in pounds per square inch of piston area, at that point in the piston stroke.

Next proceed to trace the diagram of rotative effect. To do this, measure the height of each of the ordinates 1, 2, 3, etc., above the base line *o d*. Multiply this height by the corresponding decimal in the table just given, and lay off the resulting pressure on the same ordinate. In this way we shall obtain a diagram *o d d d d*, the height of which at any point represents the rotative effort exerted at that point of the piston stroke.

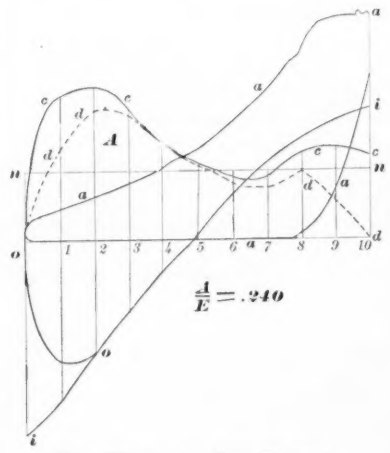
The average height of this last figure is now to be found. This can be done either by means of the planimeter or by the older fashioned method of dividing the diagram into ten or more equal parts and carefully measuring the average height of each division, taking, finally, the average of all these measurements. A line *n n* is then to be drawn at a distance above the base line equal by scale to this average height.

Now the result of all this is that we have a diagram which shows us at a glance just to what extent the *rotative effort* varies during one stroke. We see that at about $\frac{1}{12}$ stroke it rises considerably above the average, and stays so till a little later than $\frac{1}{4}$ stroke, when it falls below, and remains so till the piston is at $\frac{1}{12}$ stroke again.

Since *n o* represents force and *o d distance*, the area *n o d n* represents the work done per stroke by the rotative force. Similarly the area *A*, found by the rotative effect curve running above the average, represents the work done above the average during the portion of the stroke when the curve is above the line *n n*. Then the ratio of *A* to *n o d n* will give the ratio of the *fluctuation of energy* to the whole energy for one stroke. In the case before us this ratio is about $\frac{1}{4}$; more exactly, the fluctuation amounts to 0.240 of the total energy for one stroke, and this is the form in which the result will be needed for the formula soon to be given.

This is, as I believe, the way the design of a fly wheel for steadiness should be begun. To carry it out, a diagram should be taken from the engine under a brake load about equal to its rated power, cutting off at closely $\frac{1}{4}$ stroke, and with conditions of steam pressure, etc., good averages.

This diagram should then be treated as has been described.



FLY WHEELS.—SEE PAGE 1.

(*Porter-Allen Engine* 11¼″x16″, 265 *Revolutions.*)

I have plotted very many such diagrams, and have studied the matter with great care for some time, in the hope of being able to give the readers of the AMERICAN MACHINIST rather more definite data; and I wish to state now, for the benefit of any who may be disposed to criticise the methods and conclusions of this paper, that, if it is wrong, it is very wrong indeed. This has been gone over many times, and if there is any flaw, I cannot find it. I cannot make the plea of haste or inadvertence, and will take full blame. In all this work, however, I have failed to find an answer to the question, "Is there not some value that can be taken for this ratio of fluctuation to total energy which will be a good average?' The ratio varies with valve setting, weight of parts, speed (very rapidly), steam pressure, and length of connecting rod. Morin studied the same matter, and values are given, for engines cutting off at different points in the stroke, in Professor Rankine's book on "The Steam Engine," pages 60–61, but my own plottings, based on modern engines and from actual indicator diagrams, do not show any regularity which would warrant a general average value. And I believe it will be found best to determine the constant for each separate size and type of engine built.

Moreover, in order to secure as accurate a result as possible, it will be found best sometimes to take diagrams from both ends, and take the average of the two constants found as the true one. And now, having explained thus far, I will give a formula with no explanation except this general one: That the formula is based on the fact that the tendency of this fluctuation of energy is to produce corresponding fluctuation of speed, and that the wheel is to be so proportioned that by the momentum of its rim it will reduce this fluctuation of speed by a definite amount. I give no further explanation, because the formula is boiled down from Rankine, and has taken considerable time and study, and the explanation would either be incomplete or wearisome, so let it go.

Let A = area piston in square inches.
L = length of stroke in feet.
r = average rotative force in pounds per square inch for one revolution, as found by the diagram.

Then $2\,A\,L\,r = E$, which will represent the total energy exerted rotatively for one revolution.

Let v = velocity of fly wheel rim in feet per second.
c = the ratio of fluctuation to total energy per revolution.

Let W = weight of fly wheel rim in pounds.

Then the weight of rim necessary is found by the formula:

$$W = \frac{3{,}600\,E\,c}{v^2}$$

the value of E being found previously as above.

When, as in most modern high-speed engines, the functions of the fly wheel are divided between two driving pulleys, this formula gives the combined weight of both rims.

I naturally feel some trepidation about publishing this paper, as the AMERICAN MACHINIST recently stated, in answer to an inquiry, that there was no formula for proportioning fly wheels for steadiness which was thoroughly reliable. I fully agree with our excellent friend, and this paper is not intended as a final solution by any means, but only an attempt to bring the matter down as near first principles as possible. If it, perchance, proves useful to one or two, I shall be fully satisfied.

Designing Cams.

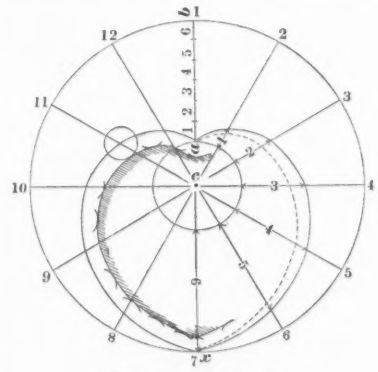
BY W. H. BOOTH.

In designing a cam, the usual points given from which to set out are a certain range of motion in the moved piece, to be accomplished during the period of time occupied in the revolution of a shaft through a certain fraction of a circle, and it is usually the case that the shaft which carries the cam has a uniform velocity. Sometimes, however, it is not merely desired to drive a piece from *a* to *b* in a certain time, but at a certain velocity. For example, in what is known as the copping motion of a spinning frame it is required to raise and lower a rail, which controls the winding of yarn upon the spools, at a uniform rate or very nearly so. For this purpose a special cam, known as a heart wheel, is employed, which gives the uniform motion required.

In the practical design of a cam it is necessary to first design a theoretical cam or one which will give the motion required to a point. This determined, the actual practical cam is deduced from the theoretical form very easily. As an example, suppose in Fig. 1 we wish to move a point evenly from *a* to *b* and back again; let us design a cam to do so.

Extend the line *b a* to *c*, and take the distance *a c* sufficient to give a sufficiently strong central spindle. Then with *c* as a center, strike circles through *a* and *b*. Divide *a b* into any convenient number of even divisions, and draw as many diameters through *c* as the number of divisions of *a b*.

Then starting at *a* equal zero, pass on successively to each radial line and set off dis-



DESIGNING CAMS.

tances from the circle through *a*, equal to one, two, three, four, etc., of the divisions into which *a b* has been divided—in this case six.

Then through each point thus found on the various radii, draw the cam curves. This heart cam revolving round the center *c* will give a continuous uniform motion to a point to and fro along the line *a b*, or along any other radius.

Such a cam is perfectly useless, however, for there are no points outside of the geometrical ones, and our practical cam will be required to drive a friction roller in all likelihood, perhaps 1¼ inches diameter. To find the real cam which will give to a friction roller the same motion that a point receives from the cam already drawn, take a pair of compasses, and set them to the radius of the friction roller to be driven, and with one leg on the theoretical cam outline draw a number of circular arcs inside this, as shown, only very much closer together. Then a line touching these small arcs, and shown hatched in Fig. 1, will be the true outline of a cam, which will serve the required purpose.

This is a simple arithmetical spiral cam. A logarithmic spiral may similarly be drawn by the usual rules for such spirals, and reduced to a practical outline by the exact same process.

The chief difference comes in, of course, at the points of change of motion *a* and *x*.

In winding yarn on a cylindrical spool or bobbin, it is preferred that the full spool shall be barreled somewhat.

This implies, of course, a slightly slower motion for the middle of the rise and fall, so as to heap up the yarn. The theoretical cam for this would be of the form shown by the dotted lines in the right-hand half of the figure, opposite to the practical form side, but the discrepancy between the two theoretical lines would be less than purposely here shown exaggerated.

From this dotted theoretic cam the practical barreling cam would be found, as before, with the radius of the friction roller.

The great advantage of a cam motion is that any motion at all possible can be exactly obtained with unerring precision, hence the numerous cam gears found in textile machinery where quick movements require to be made under the action of some other moving part. Amongst these may be classed the shaper rail or copping rail, the heart wheel just described, the strap shifters of the mule head-stock, and sundry loom gears. After all, a cam is but a wheel of varying radius, and though I have used so many myself, it has sometimes occurred to me that their use displays a poverty of resource in respect to link gear design. Still, to effect certain ends by link gear, which are gotten so readily by a cam, would involve complications practically impossible, at least on the score of expense, so that cam motions with their compactness and absolute accuracy carry their own justification.

Something About Hones.

"An important industry of the world is the production of whetstones," said Curator Merrill, of the Smithsonian Institution. "Civilization may be said to depend primarily for its development upon edged tools, and so it is interesting to consider the most improved methods so far devised for the sharpening of the implements used in the mechanical and other arts.

"The finest whetstones known for the sharpening of fine-edged tools are obtained from Arkansas. In that State are beds of what is called 'novaculite,' which is what is scientifically known as an 'altered schist.' This means a deposit of a flinty nature, usually combined with limestone, the rock thus produced being changed in such a manner molecularly, by processes not altogether understood, as to supply a surface most suitable for grinding. Arkansas furnishes the entire supply of novaculite for the United States, also filling a large part of the export demand, which is very considerable. The main deposit of the material is in a single hill about 500 feet high. For the sharpening of keen-edged tools, razors excepted, this novaculite is unrivaled. It is a very beautiful stone, of snowy whiteness, and is quite costly, because it has to be cut by diamond dust, owing to its extreme hardness.

"Next in point of quality for whetstone purposes is a gray, fine-grained sandstone from Orange County, Ind. It is called, indifferently, 'Hindustan stone,' or 'Orange County stone.' Very commonly it is made into long spikes for sharpening knives upon in the kitchen, and for this purpose it is far better than steel. Another sandstone employed for the same purpose is quarried in

Cortland County, N. Y., and is called, without any reason that I know of, 'Labrador stone.' It is a dark gray color.

"A still coarser whetstone, for scythes and other such tools, is made from Berea grits, a sandstone found in the neighborhood of Berea, Ohio. Also, there are certain qualities of fine-grained micaschists—a crystalline rock of quartz and mica—which are obtained from New Hampshire and Vermont, and utilized for hones wherewith to grind tools of the bigger sort. But it must be understood that there is hardly such a thing as a whetstone quarry. Nearly every quarry from which whetstones are derived is worked chiefly for obtaining building stone, the small pieces of particularly fine grade only being utilized for making whetstones.

"Three stones imported from abroad are employed in this country for whetstones. Best known of these is the German razor hone, which is commonly used by barbers for sharpening their razors, and is, in all probability, the best substance for the purpose known. It is found chiefly near Ratisbon, Germany, in the old river bed. During the period of early geological formation, the river brought down to that point mud which was deposited on the bottom. This mud varied in material from one season to another, depending upon the source from which it was derived, so that during one year it was white and during another blue. Subsequently, in the course of ages, the mud became stone, and now the white layers serve to sharpen the blades by which civilized men all over the world keep their faces clean of hair. Because the white stone is costly, it is usual to back a thin slab of it with another slab of the cheap blue stone, fastening the two together with cement. Such is the ordinary razor hone of commerce. These German hones cost only a fraction of what is charged for novaculite scraps of the same size, but there is a duty upon them, which, together with the expense of transportation, renders them about as high in the market. There are two other foreign whetstones commonly used in this country. One of these is a fine-grained schist from Scotland, known as the 'Water of Ayr,' and used much by carpenters and stone cutters for rubbing down the surface of other stones. The other is the 'Turkey oilstone,' resembling novaculite.

"The stones used in this country for grindstones are mostly from Ohio and Nova Scotia, the latter supplying the best grade, which does excellently for scythes. Of foreign grindstones, most come from England. Of all whetstones the most curious and interesting are those which are utilized by engravers to sharpen their engraving tools. They are of every shape imaginable, from long needle-like points to fine-edged sticks, the object being to grind the little points and edges of the steel instrument which could not be sharpened upon an ordinary stone."—*Washington Star.*

Abrasive Processes in the Mechanic Arts.

BY JOHN RICHARDS.

(From a Paper Read Before the Technical Society of the Pacific Coast.)

WET STONE GRINDING.

Abrasive cutting is performed by means of wet stones, sand, emery, glass, corundum, crocus, rouge, chilled globules of iron, and in some cases by soft, friable iron alone. Chief among these methods is that of wet stones, or common grindstones, which form a more important part of converting implements than is commonly supposed.

It is common to consider a grindstone as a kind of simple contrivance for rough work, not involving any operative conditions worth considering, but this is a great mistake. It is true, that in sharpening tools and other operations where an indefinite amount is cut away, and the material is held in the hands, or applied by yielding pressure, the operation is simple enough, but as soon as gauge or positive grinding is attempted we have a totally different process, one involving intricate and difficult conditions that a century of endeavor has not put into a scientific or even understood form.

In proof of this let me point out that if a wet stone grinding machine for exact dimensions is wanted, there is, perhaps, not a firm in Europe or America where such a machine can be ordered without supplying plans for it, nor is there, outside of the factories where such machines are developed, any knowledge of the processes that will permit the construction of such machines.

GAUGE GRINDING MACHINES.

Before proceeding to consider gauge grinding machines, it will be proper to mention that they are not exceptional. Saws of all kinds, from the tiny web, one-eighth of an inch wide, up to the huge circular saw, 6 feet in diameter, are all gauge ground by machinery on wet stones. Some of these machines cost many thousands of dollars, and on this process more than any other does our modern manufacturer of saws depend. Carpenters' steel squares, files of all kinds, smoothing irons, spindles, gun barrels, and in some cases small shafts are *gauge* ground. The nearest organized works I have known at which gauge grinding machines were manufactured, were those that existed twenty years ago at Cohoes, N. Y., where an ingenious mechanic, by the name of Blake, constructed wet stone machines for various kinds of work. I visited his works in 1865, when he was engaged in constructing machines for grinding files, squares and other kinds of tools. Since that time, and especially during the ten years that succeeded, Mr. Baker, of the Disston Works in Philadelphia, Pa., developed a great deal that was new in grinding, discovering certain rules or principles that in some degree gave promise of a more scientific understanding of the processes.

Mr. Baker, who is better known here as the inventor of the blowing machines that bear his name, is, perhaps, the greatest expert now living in the art of wet grinding. He is also a mechanic of eminence in many other branches, but wet stone grinding, he claims, has presented the most difficult problem he has met with in the Disston Works, and in other large works of an analogous kind where he is now engaged, if living.

Mr. Blake, before mentioned, removed to England, where, I am informed, he now carries on an extensive business in grinding for the trade. His method consisted of an endless platen, or chain of platens, revolving in front of the stones, the plates or tables being guided as they passed the point of contact, so as to present the pieces in various positions, they being fastened on the plates by means of clamps. The difficulty encountered, and the main one presented in all kinds of wet stone grinding, was the rapid wear of all rubbing or running parts.

The endless platen method has gone out of use unless yet practiced by Mr. Blake himself, and present methods are by means of carriages mounted on wheels, the axle bearings of which can be protected, and by means of radius frames that swing from a pivot. This latter is applicable to forms of any kind that can be bent to suit the curve, and thus be ground parallel.

CONDITIONS OF GAUGE GRINDING BY WET STONES.

Among the conditions of gauge grinding by wet stones may first be mentioned the arc in contact. This cannot well exceed three-eighths of an inch, even for large stones, and where there is a flood of water. This may seem a strange proposition, but it is the rule adopted by Mr. Baker, and is fully confirmed by my own experience. It is true that a plane, meeting a circle, presents but a point of contact, but even a small film cut away, as the work is moved along, presents this amount of contact, especially with large stones, and as soon as that area is exceeded, water is excluded, the pores of the stone fill with metal, the work is heated, and either spoiled or "pulled" out of the machine.

In a machine I constructed, about 1886, using stones 6 to 7 feet in diameter and 12 inches thick, consuming 40 horse-power to each stone, we frequently threw the pieces out by heating. Plane irons 2 to 3 inches wide, averaging one-quarter of an inch in thickness, would be curled up like a wood shaving, turned blue, and fired into a wall like projectiles from a gun.

As a rule, the narrower the line of contact the better, hence the radius carriages that present a curved surface opposed to that of the stone work best for thin, flexible pieces.

About the same time I constructed another machine of smaller size for billet web saws, in which the pieces were fed through continuously, by means of rollers, and found that even with soft stones there were continued heating and danger, until a reversely curved bed was placed opposite to the stone so as to reduce the arc in contact, which in that case could not much exceed three-sixteenths of an inch.

The difficulty in such cases is either the absence of water, or else the filling of the interstices of the stone. It is difficult to tell which; in fact, as before remarked, the whole process is a mystery, as far as observation goes. One has to deal with "symptoms."

A second condition is the element of elasticity. What this has to do with grinding is by no means clear, but it is an essential feature. I mean moderate elasticity, because any yielding that would permit a stone to wear out of "truth" would spoil all.

In the large machine first mentioned for grinding plane irons, the bed or carriage was 8 feet long and 16 inches wide. It was of iron about 4 inches thick, and with its mounting weighed over a ton. It was moved by rack and pinion gearing placed in a room separate from the machine, to preserve the machinery from grit. The platen received eighty common plate irons, laid with steel on one side and tempered hard. The first experiments were discouraging, but it was soon found that a pine board one inch thick, placed between the table and the work, prevented the difficulty, unless the stones were too hard.

In most cases the elasticity due to wood framing, or tables mounted at the ends only, is enough, but there must be elasticity from some source.

The third condition I will notice is the hardness of stone. A hard stone cannot be used at all for gauge grinding, and the softer a stone is the better it will work; but there is a commercial limit in the case, because soft stones soon wear out. The advantages of a soft stone I conceive to be in the fact that the rapid wear presents continually new and sharp edges; also the water saturation because of porosity is more complete. The function of continued waste or wear will be further noticed in connection with emery wheels, or corundum wheels.

There are many cases where gauge grinding with stones has been attempted and abandoned, after expensive experiments, because the stones used were too hard or too fine. Indeed, most of the difficulties that have come under notice have been due to this cause. In some cases a lack of water has been the cause of failure. It is not enough to flood a stone with water, especially one running at high speed. The water must be shot in by a jet between the stone and the work, and distributed all the way across the face. The agency of the water is to carry off the heat, and also to wash out the sand and particles of metal cut away.

The principal development of wet stone grinding, that is, gauge grinding, has been in the large saw manufactories, and also tool factories. I do not mean hand grinding, which is simple enough and calls for no notice; but gauge grinding has been the subject of a great amount of ingenious effort in these manufactories by highly skilled mechanics who have not carried their knowledge beyond the works where it was applied.

In England a good many cemented or manufactured stones or wheels are used for wet grinding. At the works of George Richards & Co., Manchester, such stones or wheels are used for grinding wrought-iron pulleys, and a careful account of expense and time shows a saving over natural stones, although the latter are much cheaper in first cost.

The stones employed are, at the beginning, about 4 feet in diameter and 6 inches thick. I am not aware of the kind of cementing material used in their manufacture, but it is in a limited degree soluble in water.

DRY STONE GRINDING.

There is but little dry grinding done in this country, and, so far as known, only on stones brought here from England.

It may have been noticed that the shanks of tools brought from England, chisels, for example, are ground crosswise, and are very rough. This is done on small stones driven at high speed, called "shank stones." They were formerly employed for the same purpose at the Barton Wool Works, in Rochester, New York.

Their operation is apparently the same as that of a coarse emery wheel, and the mystery is that they do not "glaze" or fill with metal; but there is some peculiarity in their structure that keeps them clear. I imagine they would soon fill if applied to gauge or positive grinding.

A stone when glazed or filled ceases cutting or abrading, and some kinds, granite, for example, are suitable for the bearings of shafts. I have myself seen in several cases in Sweden the main or water wheel shafts of saw-mills mounted in granite bearings, and in one case had a shaft lifted to examine the surfaces, which were polished and had a metallic appearance.

The tendency to "pull," as it is called, in dry grinding or in common grinding, when a stone becomes too dry, is a phenomenon not easy of explanation. For example, if we have to turn off a grindstone, either in its manufacture or to make it true in use, a hard or sharp implement is of no avail. It must, on the contrary, be of soft iron or steel, and held in a dragging position on the face of the stone. A piece of common gas pipe is often used for this purpose.

When the tool takes hold, which it will not do unless the conditions are right, it will "hang on," tearing out a deep furrow, and apparently cling to the stone. Only a blunt end is required, and, strange to say, complete elasticity is essential.

For this purpose it is common to use a steel rod, large enough to be held in the hands, five-eighths to three-quarter inch in diameter, but the cutting end is drawn down to three-eighth inch square, a slender rod which bends freely when it takes hold of the stone. All this, so far as is known, is unexplained phenomena, familiar to shop practice as a fact, but a mystery so far as the nature of the operation is concerned.

In this same connection, but not to anticipate what is to be said of rolling abrasion, I will mention another method of truing or turning stone by means of rolling implements, that "force off" the material by pressure.

A small beveled wheel with a dull edge is presented to the face of the stone in a diagonal position, so as to rotate slowly with it, and is passed positively across the face, "spawling" off the irregularities in pieces at one operation. The same operation is the most successful one for shaping stone by machinery that has ever been invented, and will be treated upon in a future place.

Unless these facts suggest some explanation of why stones do not glaze or fill in dry grinding, I have none whatever to offer.

Dry grinding is not uncommon in England. Razors for one thing are dry ground, and I believe also many other implements of the kind that would be injured or destroyed by the heat, which would naturally be supposed to result from that process.

ABRASIVE CUTTING BY HEAT.

This operation consists in applying smooth disks of steel or iron, driven at high speed, to pieces to be cut, the heat developed by friction being sufficient to melt the metal in contact with the wheel, or, what is more profitable, softening to plastic state, so it is rubbed or worn away by the wheel.

This operation has a place in what may be called the romance of processes. Most every one has heard of it and wondered at it, but I imagine no one has ever seen any very useful function performed by this means.

In a tolerably wide observation of manipulative processes in this and some other countries I have never seen this process but once applied in a manner or under circumstances that seemed necessary or economical, and that was in the United States Armory at Springfield, Mass., where it was employed in preparing a tenon or reduced section on the ends of tempered steel ramrods, such as were used in loading the muskets of twenty-five years ago.

The material was hard and could not be cut, so small wheels of iron about 6 inches in diameter and 1 inch thick were used. They were driven at 6,000 revolutions per minute, and melted or abraded the metal instantly, at the same time drawing the temper so that a screw could afterward be cut on the end of the tempered rod.

My own experiments have been confined to cutting off small bars of round and square iron by means of disks 12 inches diameter of 16 gauge plate. The operation was slow, unsatisfactory, consumed a great deal of power, and left the surfaces with a hard scale that afterward destroyed files or other tools.

I have also seen railway bars cut off by this method, the saws being about 4 feet in diameter and five-sixteenths of an inch thick, but so far as known all these operations have been supplanted by cold sawing with regular saws having sharp teeth, and cutting the same as a circular or band saw does in wood.

COLD SAWING IRON AND STEEL.

In respect to this last operation of cold sawing iron and steel, I will digress enough to say that it is a process of great importance, that has been at least ten years in making its way to this country. Five years ago there was scarcely a large engineering works in England that had not among its implements either circular or band-sawing machines for metal, and in many cases both.

Messrs. Cramp & Son, the shipbuilders at Philadelphia, three years ago ordered from England two of these cold saws for cutting off deck beams and other bars, and one is in use at the Union Iron Works in San Francisco. The United States Government, about one year ago, ordered from a firm in Leeds, England, a band-sawing machine for cutting metal at the Washington Ordnance Works. I know of a works in England where there are fifteen such machines in constant use.

The manufacture of cold-sawing machines has now been definitely commenced in Philadelphia, but it is a tardy beginning, considering their extensive use abroad in England, Germany and France five years before.

ACCURATE GRINDING.

Grinding is the process of accuracy. I have explained how it was the only process of treating hard material from tempered steel to the diamond, but an equally important function is the one of accuracy. Considering abrasive cutting as one of delicacy or precision, direct cutting is in comparison only a "roughing out" or preliminary process.

In metal working the operation of cutting has a limit of accuracy at one-hundredth part of an inch in coarse work and two-hundredth part in fine work. I mean in common turning and planing. In grinding, the range of accuracy comes down to the ten-thousandth of an inch in common operations, and much less in the finer operations. All accurate and all polished surfaces are finished by abrasive operations, and after this statement it may be perceived how these processes are more important than cutting with edges.

In the manufacture of gauging implements of precision, with which I was connected for many years, grinding processes opened a new field. It was at the beginning of what may be called the emery wheel period, but involved a great deal more than common grinding processes, and a good deal that is never learned in any manufacture not involving dimensions within a five-thousandth part of an inch. I do not, however, propose to go into this matter at this time, the purpose being to explain, or comment upon, some of the phenomena that attend no accurate grinding by wheels.

The manufacture of emery grinding wheels as now carried on is not what it should be. A dozen or more companies are making and recommending their particular wheels as superior to all others, but as to how these wheels are cemented or made, there is no knowledge whatever. As a matter of fact, there are certain kinds of cutting material, and certain kinds of cementing material that are best for particular processes, and it is certainly time this was a matter of common knowledge among mechanics and manufacturers. The requirements demand a very wide range of quality in such wheels, and there should be something more reliable to depend upon than the trade secrets and circulars of makers.

While the attempts to grind caliper and other gauges already alluded to were being made, Prof. John E. Sweet, of Cornell University, came to the works, and, as an act of disinterested kindness, placed at our disposal the knowledge he had gained in several years of experiment in accurate grinding at the laboratory of Sibley College. This information, although valuable and expensive, was discouraging, in the fact that his conclusions were that abrasive grinding could not be done without pressure, and with pressure accuracy was impossible, except as a "trial" process.

Let me explain here that trial operations are not admissible in any organized process for the duplication of work. One may "cut and try," and thus secure accurate dimensions, but this is not manufacture, in a commercial sense, for our time at least, and was not applicable to standard gauges. Implements so made would cost a great deal, and would be of no commercial use for that reason. In the duplicating system of making small arms, for example, if any part is touched by a file, or any implement that is hand guided, that piece is lost. It becomes special. In Geneva, twenty years ago, when watches were made by hand and trial fitted, such watches could not compete with those made here when the rate of wages was ten times as much as in Geneva. Trial work is of no use in the accurate fitting of any article to be reduced to a manufacture, so that Prof. Sweet's conclusions were discouraging. Thousands of dollars worth of gauges and machinery were made and lost at the gauge works, until light came from an unexpected source. I am speaking of twelve years ago.

Some years previous to that time, J. Morton Poole, of Wilmington, Del., introduced a system of accurate grinding for calender rolls for paper making. These rolls, some of them 7 feet in length, had to be made for rolling tissue paper, which will pile 2,000 to 4,000 to an inch of thickness, and variations of one ten-thousandth of an inch in diameter or alignment would distort the paper as it passed through the rolls. Mr. Poole had exhausted the emery wheel market, as we had done, and ended by advertising here and in Europe for samples of emery and corundum. He collected such samples and established a laboratory for experiment and the manufacture of wheels, and, finally, after many failures, produced those that would grind without pressure.

This was done by cementing the wheels with substances soluble in soda water, using the sharpest corundum carefully assorted. When the wheels were at work a stream of alkaline water was run upon them, so the surface was continually but slowly melted away, and each time the wheels turned around, so to speak, new edges were presented to the work, and when the conditions were favorable the cutting went on without appreciable pressure. This was the lacking feature, and through his skill and suggestions the gauge business succeeded.

Let me explain respecting pressure, that the flexure and yielding joints in the most carefully constructed machine, even under light pressure, are enough to destroy the accuracy of these processes, and also, as flexure is accompanied by heat, the distortion from that cause is a further difficulty. The same rule applies in all accurate abrasive grinding, and quite the reverse of what has been noted of wet stone grinding. Pressure always produces flexure and distortion.

Fig. 17.

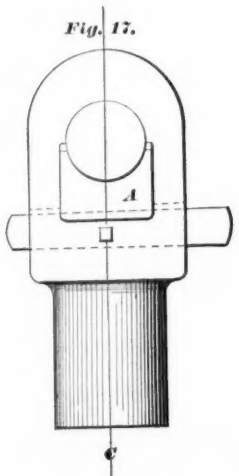


Fig. 18.

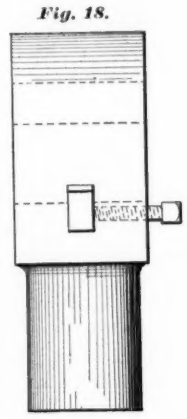


Fig. 19.

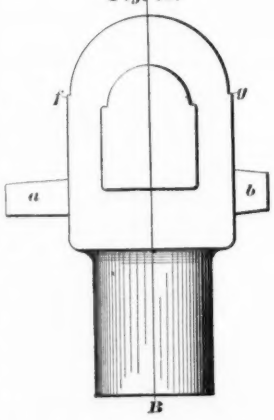
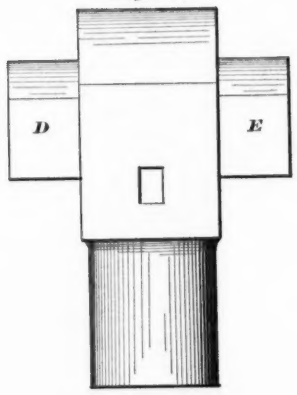


Fig. 20.



PATTERN MAKING.

Fig. 21.

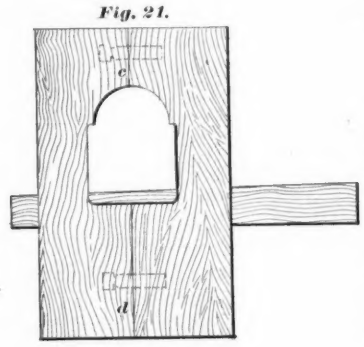
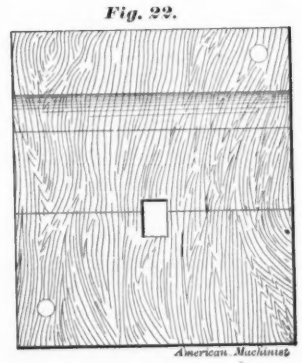


Fig. 22.



Pattern Making.

BY P. S. DINGEY.

KEY HEADS FOR MOTION RODS, ETC.

The cost of getting out brass key heads for motion rods may be considerably reduced in the machine shop by the pattern maker doing a little scheming, and the brass molder exercising care in molding.

Figs. 17 and 18 are two views of a key head with block *A* in place. A dry piece of cherry or mahogany should be selected, and the pattern made as shown in Figs. 19 and 20; it should be in halves, *B C* being the parting line.

D E, Fig. 20, are core prints which carry the core horizontally. After the core is located a steel key is set in the mold into the print *a*, the cope print *b* bringing the key upright when cope is being closed. The box for the core is shown in Figs. 21 and 22, and is doweled together at *c d*, Fig. 21; a key passes through this core-box, which makes a groove in the core to receive the steel key.

It is the intention when the castings of these heads are being fitted up, to file the round ends, while the sides are to be finished in the machine, therefore the stock allowed for machine finish must stop off at *f g*.

There need be no fear of chilling the sides of the holes, through casting steel keys in these heads; the effect is rather the reverse of what would happen in cast-iron, for it is well known that, if the same thing were to be done in cast-iron, the sides of the holes would be so hard that it would be almost impossible to dress them out with a file.

A number of keys should be made expressly for casting into the heads, and they ought to be nicely finished, having about $\frac{1}{64}$ inch taper sideways; this will enable them to be easily driven out. I have seen much time wasted in the machine shop making these key heads, such as drilling and clipping out the keyhole from the solid, and finishing the round end in a shaper. This led me to devise the above simple way of casting them, which has proved a great saving.

When making large quantities of these castings, a wood pattern will necessarily get broken and badly marked with the molder's vent wire, so that under such circumstances a metal pattern and core-box would be more serviceable. I would therefore propose that the standard pattern be made of aluminum and the core-box of cast-iron. Aluminum is just the metal that is wanted for such small patterns, because it possesses the two necessary and important elements most desirable for patterns—strength and lightness in weight, a very nice surface can also be made on this metal, which is also the thing needed. Molders do not like a heavy pattern, for the reason that it is not so easily drawn as a light one.

It don't take long in these days to break the record of the fast transatlantic liners. The last steamship to break it is the "Majestic," of the White Star Line. She has made the passage from Queenstown to New York, so it appears, in 5 days, 18 hours and 8 minutes, beating the record by about one hour. Next.

Speaking of Johnstown, the Jersey City *Evening Journal* says: "The relief fund has made the town richer than ever before," all of which is pure nonsense. Then it says: "They have sued the fishing club which owned the dam," which shows good sense.

Electrotypers' Tools.

Much attention has been given to the construction of electrotypers' tools by John Royle & Sons, of Paterson, N. J. Of the several kinds manufactured by this firm, we give illustrations of a few which have recently been brought out.

Fig. 1 represents a light running drill arranged for mounting upon the work bench or table. It is admirably adapted for drilling nail or screw holes in zinc or electrotype plates, and for light drilling of any kind. The vertical movements of the drill spindle are controlled by a counterbalanced sensitive lever, and the whole is conveniently arranged to facilitate operations. The guide and spindle pulleys are straight faced and flanged so as to admit the use of a flat belt for driving. This belt may be of either printers' tape or thin leather, and it can be tightened to a limited extent by a slight backward adjustment of the guide pulleys. These pulleys turn on the pin through the frame, and the spindle pulley can easily be turned so that its hub will be below instead of above, as shown. This arrangement makes these three pulleys reversible, thereby providing means for driving by either an upward or downward direction of belt.

Removable bushings are provided for the spindle bearings, which, in the event of wear, can be readily renewed. The table may be raised or lowered and fixed at any given point by means of the clamping handle, shown at the front. With this machine, holes $\frac{5}{16}$ inch in diameter may be drilled.

The general dimensions of the machine are 22 inches by 7 inches by 24 inches high. The speed of the countershaft, which is furnished with the machine, should be about 560 revolutions per minute. Total weight, including countershaft, is 65 pounds.

Fig. 2 represents another light running drill, similar in construction in every particular to the foregoing, with the exception that the machine is set on a column. The tight and loose pulleys are 4 inches diameter by $1\frac{1}{4}$ inch face. The floor space required is 18 by 24 inches. The weight of the machine, complete, is 160 pounds.

In both machines the spindle is $\frac{11}{16}$ inch diameter, and it has a vertical movement of $2\frac{1}{2}$ inches. The table has a vertical adjustment of 3 inches. The diameter of the table is 7 inches; and the clear space to center of drill is $5\frac{1}{2}$ inches.

SHOOT-BOARD AND PLANE.

In the outfit of an electrotyper, photo-process engraver, pattern maker or joiner a good shoot-board and its plane are important and valuable tools. Fig. 3 is an illustration of these, for which is claimed a high grade of excellence, embracing new and important features. The underside of this board rests upon three points, thus insuring a perfectly steady and true surface upon which the work to be planed is placed.

To the forward part of the board are cast lugs or hooks extending downwards, which bear against the edge of the work bench, and afford sure means of holding the shoot-board in position for use. The moving of the board to any convenient place on the bench at any time is a simple matter, as there are no screws to remove.

An improved handle upon the plane affords not only a comfortable but a firm and commanding grasp by which its movement is easily controlled. This is a matter of great importance, and it will commend itself to the workman.

A solid steel knife or "iron" is furnished with the plane; it can be inserted, removed, and successfully adjusted without the use of a hammer. By an adjustment of the "frog" or bed portion of the knife, the width of the throat can be regulated; a lever arrangement of cap securely fastens the knife in place; the thickness of the shaving is governed by means of a screw, shown at the back of the "frog"; and in the same region a lever is fixed by which the knife can be set to cut square.

Both the board and the plane are entirely of iron, with carefully planed surfaces and ways on which the plane slides. The out-side dimensions are $10\frac{1}{2}$ by 24 inches; the size of the bed is $7\frac{1}{2}$ by 22 inches. The width of the cutting knife is 2 inches; the length of plane, 18 inches. The total weight is 55 pounds. A larger size of board is made by the same firm. The outside dimensions are 21 by 32 inches; bed, 18 by 30 inches. Weight, 105 pounds.

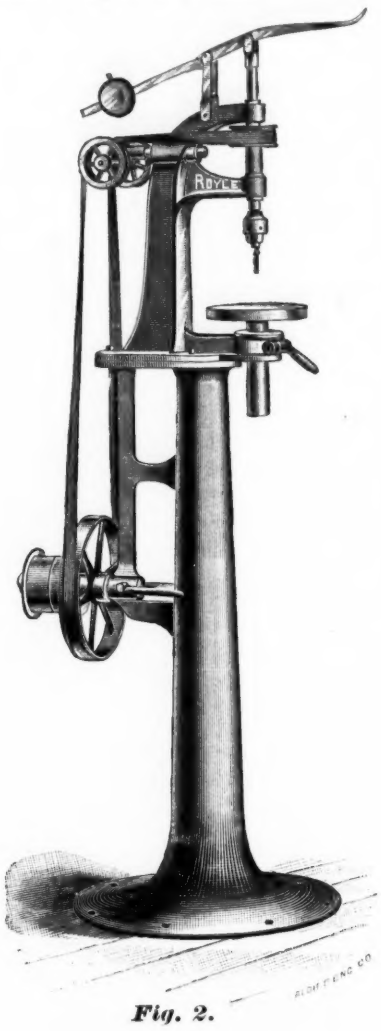


Fig. 2.

Fig. 1.

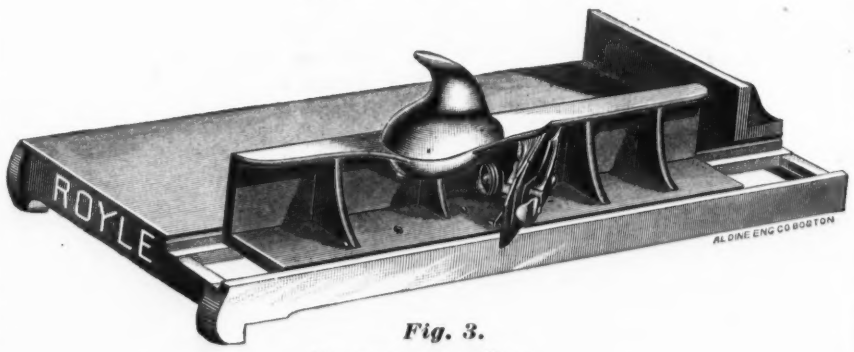


Fig. 3.

ELECTROTYPERS' TOOLS.

The United States expends upon its agricultural department and for the support of the agricultural colleges and experiment stations about $2,000,000 per annum. Germany expends nearly $3,000,000 for the same purpose. France, in 1886, appropriated $8,000,000, and Austria during the same year more than $4,000,000.

Fifty Years' Progress of British Merchant Shipping.

The following is taken from *Industries*, London. A perusal of it will give those interested in the American mercantile marine cause for reflection.

At the present time we hear a great deal about the depressed condition of our shipping interest, and to those who directly feel the depression it may appear both inconsistent and incongruous to speak of the progress of British merchant shipping. However, in times of either individual or national depression it is advisable to make a survey of the salient circumstances which have existed for some years past, and to review the whole of the conditions. We then very often find that there is little, if any, cause for complaint on the whole, and that the depression has arisen from a previous state of congestion which requires to be worked off by some means or other. When we study the record of British merchant shipping during the past fifty years, which has recently been issued by the Board of Trade, we find nothing but cause for congratulation, for the figures show most conclusively that the United Kingdom continues to hold its own amid the growing competition of other nations for the carrying trade of the world, and that, in fact, she is first in the race, and the other nations practically nowhere. In 1840, the date when shipping statistics were first compiled in a thoroughly reliable form, the total tonnage of the merchant navy of the British Empire was 3,311,538, of which 2,724,107 belonged to the United Kingdom, while last year the tonnage of the British Empire was 9,688,088, and that of the United Kingdom 7,945,071. But a change has not only taken place in the amount, but also in the kind of ships, and the great increase which has taken place in our steam tonnage during the past few years has added enormously to the carrying power of our ships. In 1840 the tonnage of steam vessels in the British Empire was 95,807, of which 87,539 belonged to the United Kingdom, while last year the steam tonnage of the British Empire was 5,413,706, of which 5,037,666 belonged to the United Kingdom. It is rather curious to observe that within the past few years there has been a decided tendency to build sailing ships for certain kinds of trade, in which rapidity of transit is a secondary consideration. Notwithstanding this tendency, the rapidity with which steam tonnage has increased and sailing tonnage decreased relatively to each other, especially during the last two decades, is one of the most marked features in the report. This fact accounts to a very considerable extent for the great increase in the tonnage entered and cleared with cargoes and in ballast at ports in the United Kingdom. In 1840 this tonnage was only 6,490,485, whereas last year it was 53,973,112. The figures which relate to steam vessels are, however, much more striking. In 1840 the tonnage of British steamers entered and cleared with cargoes and ballast at ports in the United Kingdom was only 663,048, whereas last year it was 49,023,775, or nearly ninety times greater. Our satisfaction at this state of affairs may be increased, and our feelings of depression lightened, when we look at some of the figures referring to other countries. Remembering the fact that the present tonnage of our mercantile marine is close upon ten millions, we may state that the next on the list is the United States of America, with a tonnage of 946,695 registered for oversea trade, and 3,477,802 for river and lake trade. The latter has continued steadily to increase, while the former has as steadily decreased. Even last year this tonnage was considerably less than in the year which preceded it, while in 1860 it was as high as 2,546,237. It is quite evident that the American civil war caused a great part of the carrying trade of America to be transferred to other countries, and especially to Great Britain, and that neither bounties nor the other attractions held out by the American government have had much effect in recovering the lost traffic.

It is somewhat curious to observe that, next to the United Kingdom, the country which has made most progress in merchant shipping is Norway, a fact which shows what can be done by combined intelligence and enterprise. In 1840 the tonnage of Norway was only 276,697, while in 1889 it was 1,611,398. We have heard a good deal recently about the progress of Germany, but the report shows that as regards shipping this progress is not very much to boast of. Last year the tonnage of the merchant navy of the whole of the German Empire was 1,320,721, while ten years ago it was 1,181,525, which does not show a very rapid rate of increase, especially having regard to the fact that we ourselves have built so many ships for the Germans. It will no doubt cause some surprise to learn that these statistics show a decline in the registered shipping of France and Italy. In 1840, the former had 662,500 tons, and for some years this amount was increased, until in 1870 it had reached 1,072,048, but ten years later it had fallen to 919,298. A smaller increase then took place for a few years, and then again a decrease, and the amount is now 932,735 tons. Italy, which in 1870 had 1,012,164 tons, had in 1889 only 824,474. Both Italy and France have had what their shipowners consider the advantages of bounties, but what experience distinctly shows to be disadvantages. The free and unfettered competition of this country stimulates the energy and intelligence of our shipowners, and a small amount of these qualities more than counterbalance very considerable bounties. The merchant navies of Belgium and Holland are not very important, but the report shows that they are both decreasing quantities, and the same remark applies to other countries. But notwithstanding these decreases, another series of tables show the very significant fact that the tonnage owned by foreign powers entered and cleared at ports in the United Kingdom is steadily increasing, and that foreign competition is being more and more felt—a fact which should be carefully noted by our legislators. Our shipowners do not require to be informed of this fact, as they are already painfully aware of it.

There is an instructive table given, showing the number and tonnage of vessels belonging to the principal maritime countries which were removed from the register on account of wreck in each of the years 1870, 1875, and 1878–89, and of course in

this the British Empire also heads the list. It is, however, satisfactory to find that for some years past both the number of wrecks and the tonnage involved have been decreasing. In 1889 there were 570 wrecks, with a tonnage of 218,409, the total tonnage last year being 9,688,088. It is also satisfactory to find that the proportion between the tonnage wrecked and the total tonnage is smaller for the British Empire than for other countries. Norway, for instance, in 1889 had 168 wrecks with a tonnage of 60,906, its total tonnage in 1889 being 1,611,398. The report contains a considerable number of other tables of great interest, to which our space will scarcely allow us to allude. One gives the tonnage of vessels built in the United Kingdom in each year from 1858 to 1890. In the first-mentioned year the total was 236,554 tons; the highest figure was reached in 1883, with 892,216 tons, while last year the amount was 812,638 tons. In France, on the other hand, shipbuilding has decreased in a remarkable manner, the total tonnage built in 1889 being only 32,502, in addition to which, however, 24,676 tons were bought abroad. Details of trade with different countries, returns of apprentices, of seamen's wages, of persons employed, of seamen's savings banks, and of other matters go to complete this important report. Its perusal is well calculated to give us heart for the future, and to remove any feeling of depression which may arise on account of the present dull state of the shipping trade.

It Didn't Stop.

The train had only started from the New York end of the bridge when he went to the door of the car and asked of the guard:

"Does this train stop before it gets to Brooklyn?"

"No, sir."

"No half-way stop, eh?"

"Of course not!"

"What do you mean by of course not?" persisted the man.

"Why, you ought to know that it doesn't!"

"I had, eh? Mebbe you've got an idea in your head that I run this mammoth old village and the bridge included, but if you have, I want to inform you that you are mightily mistaken! The only thing I run on this earth is a tannery about forty miles up the river, and they say I'm running that into the ground as fast as possible."—*M. Quad.*

LETTERS FROM PRACTICAL MEN.

Stress in Fly Wheels.

Editor American Machinist:

I have read with much interest, in your issue of July 30, the excellent article relating to stress in fly wheels, by Professor Joseph Torrey. He has certainly presented the subject, which is often shrouded by ambiguity, in a very simple and comprehensive style. But it appears to me that his formula for finding the stress per square inch of section of the rim is, on the whole, not as simple and easy to remember as the rule given by Mathias Beck in your issue of April 19, 1884, which is: The strain per square inch of pulley rim section is one tenth of the square of the velocity in feet per second, nearly. Expressing this rule in symbols, we have:

$$S = V^2 \times .1,$$

in which S denotes the stress per square inch of section of the fly wheel rim; V, the velocity in feet per second of a point in the center of the section of the rim, which, for the sake of brevity, we shall, in what follows, call the velocity of the rim. Since there is no proof of the correctness of this rule given, or how near correct the results obtained by this rule will be, it may be of interest and benefit to some of your readers to investigate this subject.

Let B in Fig. 1 be a small body which is to move in a circular path in a horizontal plane. To cause it to do so we must do one of two things: we must provide for it a circular guide G to keep it in its orbit, or we must attach it in some way to the center C, say by a string. Let us now consider the conditions when the circular guide G is used. If the body B is set in motion by a force F acting in a direction perpendicular to the radius r, and if there is no friction nor other resistances the body will continue to move in the circular path set out for it. If there had been no guide, and motion is given to the body by the force F as before, then it must be evident that the body will move in a straight line, or tangentially to the required orbit. Consequently the duty of the guide G, when used, is to constantly deflect the body from the path it would take if left unconstrained. Our guide G, then, exerts a force which always acts towards the center C. It is this deviating force that we have really to deal with in computing the stress in the rims of fly wheels. But in practice it is generally the centrifugal force which is spoken of. This would be a matter of indifference were it not for the fact that the term "centrifugal force" has given rise to the idea that the body tends of itself to move away from the center, instead of tending to move in a direction tangentially to the circle. Professor Rankine gives the following definition: "Centrifugal force is the force with which a revolving body reacts on the body that guides it, and is equal and opposite to the deviating force with which the guiding body acts on the revolving body. In fact, every force is an action between two

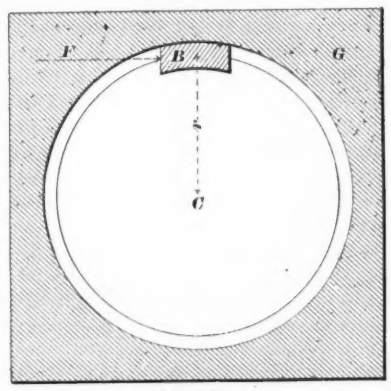


Fig. 1.

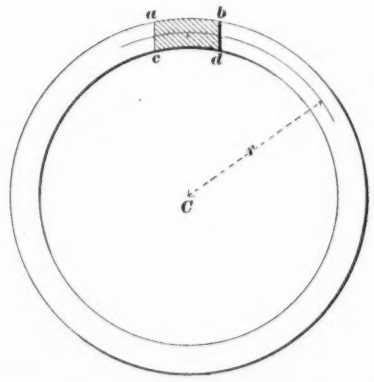


Fig. 2.

STRESS IN FLY WHEELS.

bodies; and the *deviating* force and *centrifugal force* are but two different names for the same force, applied to it according as its action on the revolving body or the guiding body is under consideration at the time." Bearing this in mind, we may use without being misunderstood the common expression centrifugal force, meaning thereby simply a force equal and opposite to the deviating force.

The centrifugal force of a body is found by the well-known formula:

$$C = \frac{W \times V^2}{g \times r} \qquad (1)$$

in which C denotes the centrifugal force in pounds; W, the weight of the body in pounds; V, the velocity in feet per second; g, the acceleration due to the force of gravity, and r, the radius of the orbit in feet.

Now let us see what the bursting effect of this centrifugal force will be. Let Fig. 2 represent the rim of a fly wheel whose cross-section is one inch square, and let the shaded piece, $a\ b\ c\ d$, be one inch in length of the rim, so that its volume is equal to one cubic inch. The centrifugal force of this shaded portion is found by Formula 1; and if this force is greater than the strength of the metal, then the shaded piece will no longer travel in the circle, and the rim will burst. If we now assume the whole rim to be divided into a number of pieces like $a\ b\ c\ d$, and find the centrifugal force of one piece, then we know the pressure per square inch of rim tending to burst it, or straining the rim, just as steam pressure strains a boiler as Professor Torrey states. Hence it follows that in order to find the stress in the rim we apply the same rule as is used for finding the stress in a boiler shell; that is, we multiply the pressure per square inch as found above by the radius in inches. Now remembering that the pressure per square inch is equal to $\frac{W \times V^2}{g \times r}$, and that in this expression r is taken in feet we obtain:

$$S = \frac{W \times V^2}{g \times r} \times 12\ r,$$

in which S denotes the stress per square inch of section of the rim of fly wheel. This reduces to

$$S = \frac{12 \times W \times V^2}{g}. \qquad (2)$$

The value of g is generally taken at 32.2; and if we take the weight of a cubic inch of cast-iron to be equal to .26 of a pound, and substituting these values for the symbols in Formula 2, we obtain:

$$S = \frac{12 \times .26 \times V^2}{32.2},$$

which further reduces to

$$S = .096 \times V^2. \qquad (3)$$

In place of the factor .096 we may use, without any great error, the factor .1, and thus obtain:

$$S = V^2 \times .1 \qquad (4)$$

as stated in the beginning of this article.

To show the application of this formula, let us take the example given by Professor Torrey. What is the stress in a fly wheel 14 feet diameter making 225 revolutions per minute, and having a rim whose cross-section is one square inch? The mean circumference of this wheel is 43.98 feet, hence its velocity per minute will be $43.98 \times 225 = 9{,}895.5$ feet; and the velocity per second will be $\frac{9{,}895.5}{60} = 164.9$. Then, according to Formula 4, the stress will be equal to $164.9 \times 164.9 \times .1 = 2{,}719$ pounds per square inch. Professor Torrey's answer is 2,642 pounds; the slight difference in these results is not worth quarreling about.

B. ERLIN.

Copper and Tin vs. Copper and Zinc.

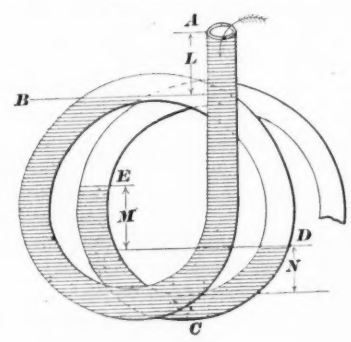
Editor American Machinist:

Every observing workman in the machinist trade has noticed the poor quality of the brass castings, as regards hardness and wearing capacity, and every engineer of high-speed engines knows how difficult it is to maintain cool brasses. It is common enough to find "copper and tin" in the papers, but a rare thing to find it in the shops. The workman doesn't usually worry much about it, but he thinks how infernally mean the Old Man is to use cheap brass. The revelation comes, however, when the workman assumes the position of the Old Man, and has the ordering of these castings. It is easy to order copper and tin 8 to 1, but quite another thing to get it. When the chips fly all over the shop with a vicious chatter and snap, he realizes that he has been swindled. No copper and tin about that, nothing but the inevitable copper and zinc. None of beautiful gold and purple colors in the chips, and not a chip with a curl to it. If he remonstrates, he gets a little more lead next time, for coloring, but copper and zinc just the same. It doesn't matter that his contract specifies copper and tin, he has to use what he can get, in the hope that the customer may not get onto the chemistry of it, or by some caprice of nature the journals may run cool.

Pure gun metal is much more rare than most men know of. It has been the misfortune of the writer to have never been able, in 22 years' experience, to procure honest copper and tin castings to order, and although we have made the utmost endeavor to get that quality in all cases, we never have succeeded except when we made it ourselves. This observation covers a variety of work wherein pure gun metal is imperative, and applies to many brass foundries. No offer of increased price has ever made any difference, nor does it help the matter to specify "for acid water"—the quality comes just the same. I believe all shops fare about the same way, judging by the brasses that are brought here for repair.

One year ago we ordered a composition water end for a steam pump from a leading eastern factory, to be used in a mine, in acid water, and which was specified to us to be copper and tin and phosphor bronze. That pump ran less than two months until it was sent in for repair, its cylinder literally worn out. It had to be lined, and the best composition we could get, although none of the best, is working yet, but has been re-bored twice since. Genuine copper and tin necessarily costs more, but it wears much better, not only in pumps, but for all purposes, but is practically unobtainable. I have known parties to make water-works valves and seats of 150 to 1,000 pounds of copper and zinc, when ordered copper and tin, and chuckle over their smartness. There seem to be tricks in more trades than ours.

"What private griefs they have we know not, that make them do it; they are wise and honorable, and will no doubt with reasons answer you." C. W. CRAWFORD.



Flow of Water in Coils.

Editor American Machinist:

In looking over the answers to correspondents in the June 18th issue of the AMERICAN MACHINIST, my attention was called to your reply to McF. & Co., Central City.

You answer that it is the friction that prevents a low head of three or four inches from causing the water to flow through a circular coil when laid down in a horizontal position.

As I have had quite a little "fun" circulating water through coils, I would like to call your attention to the enclosed sketch, which I think will throw some light on the subject.

Water being turned in at A, it rises in the first coil to B, the bottom of the interior of pipe at top of coil. It flows down in a broken stream and fills the bottom of the next coil, the water rising equally on each side.

The water soon forms a trap at C, and the air in the pipe, between B and D, has no means of escape. This compression of the confined air prevents the water rising higher than about D, when the head L is equal to the pressure of the air. The rise of the water on the other side M would be equal to the height N, plus the head L. In order for the water to flow through the coil, the head must equal the height of *all* the coils minus the compression in all the coils, or the head due to it. A vent at the top of each coil would prevent any trouble, and the water would flow with but the slightest head. Monometer gauges and portable barometers are constructed on this principle.

W. S. HOWARD.

He Objects.

Editor American Machinist:

When Bell Crank writes anything to the AMERICAN MACHINIST, I notice that he has a habit of saying things that are usually about right, but one thing in your issue of Aug. 6th, I think he is a little bit off, viz., the piece of old belting tied to the planer tool to raise the tool when the table is running back. Now, I frequently use the same device when finishing cast-steel, but I make my piece of belting long enough to

pass entirely under the point of the tool. If I used the leather as short as Bell Crank represents it the tool would drop on the work at the end of the stroke, and break the point off.

In the same issue, in the editorial that you reprint from *The Engineer*, headed "The Education of an Engineer," one paragraph probably strikes the average American mechanic as being rather odd. I refer to the place in the third column, where it says that the young engineer waiting at a station may see half a dozen engines, no two of which will have their links made or hung in the same way; now, in this country, out of six engines the chances are that at least five of them will have their links both made and hung practically the same way.

CHAS. A. TRASK.

Said to be an American Invention.

Editor American Machinist:

We notice on your first page of this week's paper that you refer to the "Greathead system" of tunneling. We think that, as you are good Americans, you should give the proper name to the system, being an American invention, recently adopted in England. It is the Beach system.

WATSON & STILLMAN.

[As our correspondents intimate, it is quite generally believed that the Greathead system of tunneling was originally invented by Mr. Alfred E. Beach, of New York. But in the absence of specific knowledge on the subject, we speak of the system as it is ordinarily spoken of, but with no intention to detract from any honor that should be given Mr. Beach.]

Lining Up Old Engine Lathes.

Editor American Machinist:

Your issue of June 18 has on page 5 an article, "Lining Up Old Engine Lathes," by "A Mechanic." At the commencement of the nineteenth line from top is the word "boring," which appeared out of place, and I was satisfied when I had read the article through that 'pouring" was intended. The article is a good one, and written by one who has "been there." A. L. ALDEN.

Foremen—Jig Saws—Graduated Vise Jaws—Ball Bearings.

Editor American Machinist:

Mr. Gilkerson's foreman is a character that will bear talking about. His attitude towards his men is the all-important feature in shop government, and having the hearty co-operation of the men means much toward a successful plant. It is just as easy to be civil or polite to men as to give orders like a slave driver. When a favor has been done for you it is no harder to say "Thank you" to the man in the shop than after he is out of it, and you would not think of forgetting to thank him for a favor done after working hours.

Nicknames are hard to avoid, for hearing the men using them in addressing each other it is very hard to call them by their right names; still, as Mr. Gilkerson says, it is the better plan. Not long ago I heard a foreman giving a "swearing match" that not only showed the disposition of the man, but lowered him in the opinion of the men. About the most interesting case of the kind that I know of happened several years ago. There was a jour. that was an habitual kicker—kicked at everybody and everything, and could not keep a boy any length of time without having a fuss with him. The foreman got tired of getting a new boy every few weeks, so he hired one that had a reputation for being a fighter. In a few days the kicking began, and the boy sailed into the jour., and walked all over him, as the saying goes; then he walked to the foreman and asked for his time. The foreman told him to go back to work. "That's what I hired you for," he said, and the boy went to work, and is there yet; he and the jour. are the best of friends, and are always to be found together out of shop hours. I do not favor pugilism as a corrector, but in this instance it had the desired effect, and showed tact on the foreman's part in selecting the means of correction.

When you see a foreman that is gruff and surly to his men, you generally find that he is afraid his men will find out how little he really knows, and by being distant and imperious he thinks that he wears an air of superior knowledge that cannot be penetrated—how mistaken is his impression we all know. The foreman that is kind to his men, and, above all, *just* to them, is the one who will secure the most work from them without driving, and will have their confidence and good wishes. This sort of a foreman is the one who is happy and contented, knowing that there is no plan being hatched for his removal, and that no honest man bears him any ill-will.

A novel scheme for avoiding the raw edge on the under side of a sawed edge of a board or plate of metal was shown to me some time ago. It was used in a large power jig saw for sawing electrotypes to the required shape for mounting. In this case the saw was nearly ¼ inch in width and rather thick, probably .04" or about that—not being familiar with the nonsensical sheet metal gauge I cannot give the number, but by the rational gauge it would be number 40. Fig. 2 shows how the saw was filed, half of the teeth raking one way, and the remaining half the other; from appearances, it seemed to me that the tendency would be to lift the work from the table on the up stroke, but the operator said it gave no trouble whatever, and as it left a remarkably smooth edge would I suppose be counted as successful.

To any one who has flat cutters, or any similar work on the programme for a great portion of the time, the centering becomes quite an item in the work. In fact, for any vise work that requires laying out we can generally find the accompanying kink useful

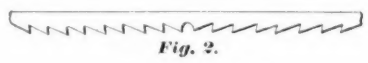


Fig. 2.

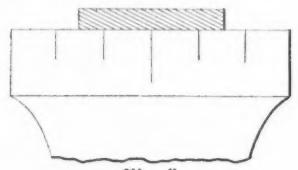


Fig. 3.

at times. Fig. 3 shows the vise jaw with a piece of flat steel in place ready for centering. Instead of using dividers or calipers for this work it is much more convenient to lay off the jaw of the vise in the manner shown. Make a center line, and then put as many sub-divisions as your work requires, preferably in inches and parts of inches, each side of the center line. With these lines as a guide it is a very quick operation to put the steel in the vise midway of the jaws, and then a center is easily made that will coincide very accurately with the center line of the jaw. These divisions will be found useful in a great variety of ways, and new uses come to view as occasion demands. The faces usually being of hardened steel can be marked with acid in a neat and lasting manner, and their usefulness must be seen from actual use to be fully appreciated.

In a recent issue Mr. Booth spoke of the adoption of ball bearings as the salvation of the bicycle business, that without them the easy running wheels would not be had, or words to that effect. I appreciate the ball bearings for their convenience in adjustment, and also their very moderate demands for lubrication, but aside from these two points I cannot see their advantage. They are more costly, and although they are supposed to run very much easier, it is not proven by any means.

At present I am riding a wheel that has a plain bearing on the large wheel, and balls on the front, but as the front wheel bears no weight they cannot be considered as having much effect on the running of the wheel. In the five years that I have ridden this machine (a pony Star) I have never met a "hard tire" machine that could coast away from it, and I have coasted with wheels of all kinds with balls in every bearing on the machine. The cushion or pneumatic tires will coast away from it, as they will from any hard tire machine in the market, all other conditions being equal. The ball bearing fad is going out, though rather slowly, for, unless I am misinformed, the Hickory wheel is built with plain bearings, and that has the name of being a very fast coaster and easy running wheel.

The convenience of adjustment of ball bearings, and the fact that they seldom need oiling (because the case retains the oil, and they revolve in it continually) are thoroughly appreciated, but I cannot agree with Mr. Booth when he says that the adoption of ball bearings has made the extended use of the wheels possible, for with the plain bearing, properly cared for, the wheels can be used and enjoyed just as much as when fitted with "ball bearings all round."

FRED H. COLVIN.

Shoes Blacked by Electricity.

The little electric shoe-polishing machines in use in a number of barber shops have excited much curiosity by the glittering effects they produce, but I saw a machine in a pattern shop down on West Fifth street, the other day, that will lay them all out.

The machine now in use consists of one whirling brush, attached to a flexible shaft, which the bootblack applies by hand. But this latest development in the way of a polisher calls for no manual labor whatever. The shinee thrusts his foot into the machine and draws it out, the polishing being completed instanter.

The contrivance is the invention of a young local mechanic. It consists of a heavy base of iron and oak, on each side of which is a circular brush, revolving on a vertical axle. In front of these brushes, and so closely placed that the bristles of the three intermingle, is a third brush, which moves horizontally.

The shoe to be shined is placed on a little platform, which slides forward between the first two brushes, and as the third brush gets in its work, the shoe comes out a glossy thing of beauty. The shafts of the three brushes are self-adjusting, somewhat after the fashion of the rocking-horse machines wherewith the inglorious hog is denuded of his bristles; and it matters not whether the shoe that goes between is of No. 7 caliber or No. 16, the polish comes on all the same.

The young genius who built this machine has applied for a patent, and is now working on a mechanical "dauber."—*Kansas City Times.*

The Reforms at Navy Yards.

The Navy Department has adopted a series of regulations to govern the employment of foremen, mechanics and laborers at navy yards, which are designed more effectually to carry out the letter and spirit of Sections 1,544, 1,546, 1,754 and 1,755 of the Revised Statutes. The regulations are to go into effect September 1 next. The sections referred to provide substantially as follows: Section 1,544; that laborers shall be employed with reference to skill and efficiency; Section 1,546, prohibiting political contributions; Section 1,754, giving preference in civil appointments to soldiers and sailors honorably discharged from service by reason of disability resulting from wounds or sickness incurred in line of duty, and Section 1,755, recommending to business men and others that they give persons honorably discharged from the naval or military service by reason of wounds, diseases, etc., preference in appointments to remunerative situations and employments. Under the regulations employes are divided into three classes, as follows: Schedule A—unskilled labor; schedule B—skilled labor; schedule C—foremen, quartermen in charge and other men in charge.

The regulations then provide that the employment of foremen, laborers and mechanics at each of the navy yards and stations shall be committed to a board consisting of three commissioned officers on duty at the station, to be called the Board of Labor Employment; the board shall consist of the captain of the yard, or officer so acting, and the senior assistant, or, where there is no such assistant, the officer in charge, from each of the two departments which employ the largest number of men. The board shall be responsible for the proper, effective and impartial enforcement of these regulations in accordance with the statutes above referred to, and shall make a report annually to the department, by September 15 of each year, of its work for the preceding year, with such suggestions in relation thereto as may occur to the members.

The new Sims-Edison electric torpedo, which is the latest invention in the line of fish torpedoes, and which has been built for the United States Government, had an official trial on August 11th. It is driven, steered and discharged by electricity. It has a cable of high insulation 2½ miles in length, being 1,000 feet longer than any of the ten boats heretofore built for the government by this company. The contract price of the boat is $12,500, and it is claimed that it fulfills all the conditions of long range, great velocity, changeable direction, a sure and controllable motive power, and a great exploding force. It is made to carry under ordinary circumstances 500 pounds of dynamite, which is said to be enough to destroy the most powerful ironclad, even when exploded at a distance of 50 feet from the vessel assailed. It is so constructed, however, that it can readily be made to carry a charge of 1,500 pounds of dynamite. The weight of this torpedo is 5,000 pounds; its length is 31 feet, with a diameter of 25 inches. The motor and generator are Thomas A. Edison's inventions.

W. Scott Sims, the co-inventor with Edison of the torpedo, manipulated the keys of the apparatus through which the electric current is transmitted to the motor in the torpedo. Its speed was 20 miles per hour. It was steered to the right and left, or any desired course, and slowing down at the will of the operator. After it had run a distance of 4,500 feet it was steered in a semi circle, and then returned to the starting point and brought to a full stop in front of the spectators. It had traveled about 12,000 feet in about six minutes. The success is considered to be complete.

There has during the past ten years been, so to speak, a race between skilled human muscle and ingenious machinery in the way of setting type. The race has been a fairly even one. There have not been lacking compositors who were ready to tackle the record of any type-setting machine ever made, on the basis of work actually required in a printing office.

It is a pity, of course, that some machine that will do the work and the thinking of the "intelligent compositor" is not forthcoming. It would give the compositor an easy time.

There is a company in Cleveland, Ohio, that claims to have such a machine. But the circular letter of this company in regard to furnishing such machines is not, to put it mildly, encouraging. For example, the circular says, in regard to orders:

First. The St. John Typobar Company will not undertake to state definitely when such orders will be filled, but all orders will be entered as received and filled in proper turn.

Second. The company will not state at present the basis on which machines will be sold or go into service, but the rates will be uniform throughout the country, and it will be the policy of the company to make these rates attractive to the publisher.

There might possibly be a more indefinite statement than this, but we hardly see how. The machine might, eventually, come at the price of a jackknife, or it might cost more than a three thousand horse power compound engine. So far, the man who picks up the type by hand, and sticks the characters in their places by virtue of knowing how, seems to be ahead.

The Navy Department is in the market for fifty rapid-firing guns, the company that controls the gun that makes the best record to receive the order.

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J. G. A. MEYER, } Associates.
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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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CONTENTS.

	PAGE.
New Pulley Clutch and Cut off Coupling	1
Steam Engine Fly Wheels. By Professor Joseph Torrey	1, 2
Designing Cams. By W. H. Booth	2
Something About Hones	2, 3
Abrasive Processes in the Mechanic Arts. By John Richards	3, 4
Pattern Making. By P. S. Dingey	4
Electrotypers' Tools	5
Fifty Years' Progress of British Merchant Shipping	5, 6
It Didn't Stop	6
Letters from Practical Men: Stress in Fly Wheels. By B. Erlin....Copper and Tin *vs.* Copper and Zinc. By C. W. Crawford....Flow of Water in Coils. By W. S. Howard ...He Objects. By Chas. A. Trask ..Said To Be an American Invention. By Watson & Stillman....Lining Up Old Engine Lathes. By A. L. Alden ...Foremen—Jig Saws—Graduated Vise Saws—Ball Bearings. By Fred H. Colvin	6, 7
Shoes Blacked by Electricity	7
The Reforms at Navy Yards	7
Fully Covered by Insurance	8
To Be Shunned	8
Navigation Inspection Laws	8
Naval Reserve	8
Here and There	8
Literary Notes	8, 9
Questions and Answers	9
Manufactures	9, 10
Wood that Resists Fire	10
Double-geared Shaper	11
Compound Engines. By James Tribe	11
Machinists' Supplies and Iron	11

Fully Covered by Insurance.

Nothing is more common than the above heading attached to the account of the destruction of a manufacturing establishment by fire. And, generally speaking, nothing is further from the truth. In the instance of shops in good running condition, manufacturing machinery, the loss that will be paid by an insurance company will only partially cover the actual loss to the firm. There is the interruption to business that sends customers elsewhere, then there is the loss of special appliances that are difficult to replace, and work must be done at a disadvantage while they are being replaced. Besides, there is the loss of patterns, and very probably all records of them, that the original cost will never reproduce—gauges, records of sizes are gone, and in a hundred ways business is hindered.

There may be—there undoubtedly are—manufacturing establishments in which a fire would be a disguised blessing. There are patterns that ought to be burned up, and drawings that are worth more as smoke than for any other purpose. But such instances are rare. As a rule, the destruction of a large manufacturing establishment by fire is in the nature of a calamity, and should be guarded against by the employment of the best modern agencies designed for the purpose.

To be Shunned.

We have frequently warned our readers against "Companies" and "Organizations," Loan Associations and the like, that propose to give them returns that can be only described as enormous for money that is deposited with them. As we have before said, there must be, in the course of things, something wrong about such proceedings. Workingmen are generally honest, and are not looking for dishonest traps and pitfalls. We are glad to note that the daily press is beginning to take hold of this matter. The following from the *Evening Post* is illustrative of the point we have been making. The extract from the *Post*, which we give below, follows an allusion to a Western concern with a high-sounding title:

A clerk in a distant city was induced to buy twenty-five of its shares at $1 each, paying $25 down and agreeing to pay an assessment of twenty-five cents a share monthly. Section 14 of the by-laws provided, in somewhat ambiguous terms, for withdrawal from the society at the expiration of six months. The clerk, after paying his fourth assessment, wrote saying he would like to withdraw and receive back his money. He received a reply from the "secretary," who quoted the 14th section of the by-laws, and told him that after he had been a member six months he could withdraw by forwarding a formal application therefor, and one dollar in cash to the society, but he would not be entitled to any dividend. The clerk waited for the expiration of the six months, and then did as directed. In reply, he was informed that the "directors'" would consider the application at their next meeting. After waiting in vain for some time to learn the result of the "directors'" consideration of his application, the clerk placed the matter in the hands of a friend in this city for collection, offering to take $50 in full discharge of the $62.50 he had invested in the society. This friend happened to be a pretty well-informed man in such matters, and he succeeded in collecting the $50, but not until the "secretary" had first offered him $6.25 (one month's assessment) in full discharge of the claim, and eventually increasing the offer to two months' assessments, and finally offering $25. He, however, at last paid the $50, but with a very bad grace.

This "clerk" mentioned by the *Post*, succeeded much better than men generally succeed with such associations; he had a streak of luck—just as if he had been struck by lightning, for instance.

On general principles, a workingman should set it down as a fact that any one who offers him an abnormally high rate of interest cannot give him good security for his money.

Professor Joseph Torrey writes us as follows:

I notice that in my paper on Steam Engine Fly Wheels, in your issue of July 30, I carlessly say, referring to the table of safe speeds there given, "Dividing these figures by 3.1416 will give the pulling or *tensile* strain per square inch of rim section in a wheel of given diameter." It should read, "Dividing these figures by 3.1416 will give the pulling or tensile strain in any two opposite sections of the rim combined, and dividing this result by 2 will give the strain per square inch of rim section."

Navigation Inspection Laws.

Recently the barge Republic, carrying excursionists from New York, collapsed—so to speak—killing several of the excursionists and maiming others. At first thought it would appear that the steamboat inspectors of New York were to blame in this matter. With such an opinion, a representative of the AMERICAN MACHINIST called on Supervising Inspector Starbuck, and was very courteously furnished with the following from the rules and regulations governing such matters. This is from the General Rules and Regulations.

Barges carrying passengers, in tow of steamers, and engaged in excursions, shall be supplied with twenty-five life-preservers, ten buckets and three axes, and one or more yawl-boats.

We call particular attention to this clause, not because it has much—or anything—to do with this particular accident, but because it is of considerable importance as being a part of the United States law in relation to navigation matters.

Twenty-five life-preservers for, say, fifteen hundred passengers! Dickens, in all his life, never wrote anything that could compare with this. The ability of a novelist to conceive of such an absurdity, and to put it into words, would insure his fortune.

The foregoing relates more particularly to the law governing barges in general. In relation to this barge, it appears to be a case of general decay. Timbers too rotten to hold together "let go," with all the sickening detail; let go just as it might have been expected they would. And if the inspection laws were what they ought to be, this barge would not have carried passengers to their death.

In connection with the whole matter relating to the killing on the Republic, we wish distinctly to state that we have found nothing that indicates that the inspectors were to blame, but in our opinion the law is remarkably defective.

The Naval Reserve.

There is not, probably, a man in the country who does not feel a certain amount of pleasure over the recent work of the naval reserve. This reserve is a contingent upon which it is hoped the country can draw, to a certain extent, in case it is ever necessary to fully man the recent and prospective additions to the navy. Still, it would be unwise to place too much dependence on this reserve. It is composed, mainly, of young men who have but little idea of ever doing the work of an ordinary man on a warship; doing his work and submitting to the fare and discipline he must submit to. There is a wide difference between playing soldier or sailor and being one in fact. Before the strained relations in this country, towards thirty years ago, there were, and especially in this State, some "crack"—we believe that is the proper term—regiments in existence. But looking through the records of the war, these regiments hardly seem to have amounted to much. It was the common sort of fellows that counted. The fellow who could live on hard-tack and salt junk, instead of, as some of the papers put the fare of the naval reserve, "porterhouse steaks and boiled eggs."

We fully believe in the naval reserve. It is a good thing in every way, but it will not be wise to get too enthusiastic over it. Young men, to indulge in the luxury of belonging to this reserve, must have an income away beyond that of the ordinary mechanic or laborer, and—well, the fighting material of both army and navy is generally made up of these ordinary sort of men. If this whole naval reserve business was so arranged as to embrace more men who work in overalls, we should have more confidence in it. Still, we have some confidence in it as it is.

Here and There.

One of our English contemporaries notes the fact, and if not in the letter, yet plainly in the spirit of commendation, that English engineering concerns are adopting still more stringent rules in regard to the exclusion of visitors. The practice in regard to this is very distinctly marked as between this country and England. It is a rather notable fact that in this country those establishments that have something worth showing are the most given to welcoming visitors.

Not long since the writer gave a recent graduate of a technical institute a letter to one of the best-known machine manufacturing firms in this country—a firm scarcely better known here than in Europe. The young man had a desire, before beginning work in real earnest, to look through the splendid shops of this company. Shortly afterwards the writer received a letter from the firm in question, stating that the young man had been there that afternoon, and had been shown around by a well-known mechanical engineer connected with the works, and that the next day he was to resume his observations.

It is only in the line of fairness to say that the letter, in all probability, made no difference as to the courtesy the young man received. Had he gone there without it he would have been shown just as much.

This is mentioned only as one instance of common practice in this country. It is not probable that there is a bit of philanthropy about it; it pays to let people know that you have good processes for doing work, and that you use these processes to good advantage.

It is plain enough to see how a man who turns out indifferent work in a poorly-equipped shop will object to a scrutiny of his processes. But in the instance of a good shop, doing first-class work, the case is quite different.

Literary Notes.

We have received Part 5 of Maxims and Instructions for the Boiler-room, by Prof. Hawkins. This part (ten of which complete the book) treats largely of the corrosion and incrustation of steam boilers and methods for preventing the losses and dangers arising therefrom. It also gives a section of chemical terms and explanations relating to feed waters, in which are defined acids, alkalies, oxides, sulphates, etc. These are subjects of the deepest interest to all who have charge of boilers and engines, and should be carefully studied. Price of each number is 25 cents. They are published by Theo. Audel & Co., 91 Liberty street, New York.

THE MECHANICAL ENGINEER'S REFERENCE BOOK FOR MACHINE AND BOILER CONSTRUCTION. In two parts. By Nelson Foley, Member of the Institution of Naval Architects, Institution of Mechanical Engineers, and North-east Institution of Engineers and Shipbuilders, assisted by Thomas Pray, Jr., Consulting and Constructing Engineer for Steamships, Locomotive Engines, Stationary Engines and other Machinery; Member of American Society of Naval Engineers, Various Societies, etc., etc. Boston, Mass., U. S. A. With Fifty-one Plates and numerous Illustrations, specially drawn and engraved for this work.

This work has been compiled and arranged, as its title indicates, to form a reference book for the members of the mechanical profession. It is divided into two parts. The first part contains general engineering data, treating of measures, circumference and areas, etc., squares, cubes, fourth powers, square and cube roots, surface of tubes, reciprocals, logarithms, mensuration, specific gravities and weights, work and power, heat, combustion, expansion and contraction, expansion of gases, steam, static forces, gravitation and attraction, motion and computation of resulting forces, accumulated work, center and radius of gyration, moment of inertia, center of oscillation, electricity, strength of materials, elasticity, test sheets of metals, friction, transmission of power, flow of liquids, flow of gases, air-

pumps, surface condensers, etc. Speed of steamships, propellers, cutting tools, flanges, copper sheets and tubes, screws, nuts, bolt heads, etc., various recipes and miscellaneous matter. With diagrams for valve gear, belting and ropes, discharge and suction pipes, screw propellers and copper pipes. The second part treats of boiler construction, including power of boilers, useful ratios, notes on construction, cylindrical boiler shells, circular furnaces, flat plates, stays, girders, hydraulic tests, riveting, boiler setting, chimneys and mountings, fuels, etc. Examples of boilers and speeds of steamships, nominal and normal horse-power. With diagrams for all boiler calculations and drawings of many varieties of boilers.

The work shows that the authors have labored conscientiously and carefully in collecting reliable information. The book does not treat of the special requirements of each branch in the profession of mechanical engineering, which are liable to become out of date on account of the new discoveries and new experiences tending to set aside the theories and practice of to-day, but deals with general principles, and gives a large amount of useful matter, which is not liable to change within reasonable time, if at all. Although in a book of reference of this kind and magnitude, space does not permit, without making the book too cumbersome, to go into all the demonstrations of the principles, and give all the elements of the different branches of engineering, yet everything of which it does treat is given in as simple and elementary form as possible, so that even the younger members of the profession, or those who have become "rusty," may understand what is given without reference to other works; and in the arrangement of the subjects, the chief feature, namely, convenience for instant reference, has not been lost sight of. The articles on the speed of steamships, contributed by Mr. Robert Mansel and Mr. R. L. Wheighton, are very valuable; and the article on electricity, by Mr. Samuel Mavor, is an interesting and useful contribution. At the end of the work drawings are added, giving not only examples of many of the principal boilers in use at the present time, but also showing what a working drawing should be, independent of the design.

In a work of this kind, which involves such an immense amount of labor, it would be strange if a few errors did not creep in; but the few we have seen are not likely to lead any one astray. Neither is the book free from all adverse criticism, because in seeking reliable information on some subjects, theories and practice are at variance with each other, and some subjects are shrouded in ambiguity; the author is therefore thrown on his own resources and experience, which may not agree with that of others. The diagrams and plates required a comparatively large page, 15x10¼ inches, and on the pages where the reading matter is not divided into columns, the act of reading is somewhat tiresome and uncomfortable. But the book, as a whole, is an excellent contribution to the literature of engineering, and every member of the profession, and all those interested in mechanical matters, should keep a copy conveniently at hand. It is published by D. Van Nostrand Company, 23 Murray and 27 Warren streets, New York. Price, $25.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet.

(371) G. H. C., Belleville, N. J., asks: Will you please inform me through your paper where I can get a cement for fastening leather to the face of iron wheels, such as are used by flour and feed men on their hand trucks. *A.*—You should be able to obtain this cement from any dealer in machinists' supplies. We are informed that Le Paige's liquid glue, or any other good prepared fish glue will answer the purpose. These you can obtain in many drug stores.

(372) G. M. B., Millersburg, Pa., writes: We harden work in a lead bath and find that the lead adheres to the work. There is something that can be put into the lead that will prevent this. Please tell us what it is. *A.*—We do not know of anything that can be put in the lead to prevent this, but charcoal kept on the surface will tend to lessen the trouble, and if, after the article is partly heated, it be withdrawn and immersed in soft soap for a minute and again put into the lead, it will come out cleaner.

(373) J. B. S., Pittsburgh, Pa., writes: Please explain what is meant by mean effective pressure. Is it the mean between the initial and final pressure, or the initial pressure minus the back pressure? *A.*—By mean effective pressure is meant the average pressure (usually per square inch of piston) urging the piston forward during its entire stroke in one direction, less the back pressure, or the pressure that resists its progress. For the rule for computing the mean effective pressure, see any of a dozen works on Steam Engineering.

(374) W. S., Wheeling, W. Va., writes: Can you explain how Charles A. Trask can draw foot-stock of lathe over for taper work, by slacking up only one of the set-screws? Mr. Trask claims he can draw one set-screw over and let the other one stand. On every lathe I ever saw, you have to loosen one set-screw and draw over with the other. *A.*—The vast majority of lathes are made with the set-screws simply butting against a lug cast on the under side of the plate for that purpose. By loosening the screw in front the center can be drawn over by hand, without disturbing the back screw, which then remains in position for replacing the center exactly in line again.

(375) H. E. S., ——, writes: I have a piece of French plate glass about 12 inches square. I want to cut it up into dials about three inches diameter, each to have a $\frac{9}{64}$ hole through its center. The glass is $\frac{9}{32}$ inch thick. Can you tell me the best way of cutting and drilling glass of the character given? *A.*—We are not sure that we can give the best method of doing this, but one way would be to use two brass tubes of suitable size mounted one inside the other concentrically, one of these being the proper size for the outside of the dials, the other for the hole through them. Supply the edges of these with emery and water, and revolve them rapidly in a drill press or other suitable machine.

(376) W. A. J., Worcester, Mass., asks: Will you please tell me the best method you know of for cutting T slots in solid cast-iron? The slots must be cut accurately. *A.*—It is difficult to answer such a question as this with any certainty of giving the best answer for the given case, because, practically, its answer would be different in different shops. To begin with, the term "accurately" is very indefinite, and means entirely different things in different shops. Generally, we should say that the best results in such work would be obtained by milling, and under proper conditions this method is certainly capable of doing such work better and cheaper than any other. But a good planer handled by a good man would beat an inferior milling machine, badly handled, especially if the limit of variation was large—say .005 inch.

(377) E. T. T., Reading, Penn., asks: What is the horse power of an engine with cylinder 18 inches diameter, 48 inches stroke; number of revolutions, 84; steam pressure, 80 pounds? *A.*—We should rate it at 207 indicated horse-power. 2. Please inform me where I can get the cook book which was noticed in your paper. *A.*—American Public Health Association, Rochester, N.Y. 3. What effect has the length of a rifle barrel on shooting? *A.*—The length must be such as to give the powder time to burn, and allow the gaseous pressure to impart to the ball the required velocity. If the barrel is made too long, friction may retard the velocity; and if made too short, the ball will not have the desired velocity as it issues from the mouth of the gun. 4. Are rifle barrels made to shoot further than others with the same amount of powder? *A.*—Yes.

(378) C. R. B., Richmond, Va., writes: Kindly inform me whether copper can be welded or not otherwise than by brazing. If so, please give the process. *A.*—The best way of welding copper is by electricity. Another way of welding copper, but which does not always give satisfactory results, is to prepare a compound of 358 parts phosphate of soda and 124 parts boracic acid. This compound is used when the metal is at a dull red heat; the heat is then increased till the metal becomes of a cherry red color, and the latter is at once hammered. A hammer of wood is recommended for this purpose, as the metal is liable to soften at a high heat; and the hammer should be used cautiously. All scale and carbonaceous matter must be removed from the surface of the copper, as the success of welding depends on the formation of an easily fusible phosphate of copper, which would be reduced to a phosphide by the presence of carbon.

(379) W. D. G., Swansea, Canada, writes: Would you kindly give me your opinion on the different positions of a boiler in connection with a puddling furnace? Which would give the best heating results, a boiler placed above the furnace, or a boiler placed in line with the furnace? What changes would you advise in the enclosed sketches, and what books to consult on the subject of puddling? *A.*—In many cases the boiler is supported on pillars above the furnace, and the products of combustion are caused to pass in a flue beneath it, or through its internal flues before entering the chimney, thus utilizing a portion of the waste heat. We prefer to have the boiler above the furnace, as this arrangement takes up less room on the floor and leaves the space around the furnace unobstructed. We cannot advise in regard to changes, as your sketch only shows roughly the relative position of furnace and boiler; the sketch is not drawn to a scale, and no dimensions are given; but from its general appearance we should say the furnace has not a correct form. We do not know of a good book which treats on the subject of puddling. To construct a furnace of this kind needs considerable experience, and if you intend to put one up we should advise you to engage the services of a first-class engineer, who is thoroughly conversant with this class of work.

(380) J. A. F., Jeanerette, La., writes: Again I come to you for information. I have read your article, "What to study and how to study," in your issue of February 19th. Being desirous to better my condition I would like to follow your advice. Will you please inform me where I could buy the books mentioned in the above article. *A.*—The Elementary Geometry, school edition; and Complete Algebra, by Prof. E. Olney; and Elements of Natural Philosophy, by E. M. Avery, are published by Sheldon & Company, New York and Chicago. Elements of Descriptive Geometry, by C. Davies, is published by A. S. Barnes & Company, New York and Chicago. Theoretical Mechanics, by J. E. Taylor; Marine Steam Engine, by R. Sennet, are published by Longmans, Green & Co. Treatise on Steam Boilers, by R. Wilson, is published by Crosby, Lockwood & Co., London, England. Elements of Machine Design, by W. C. Unwin, is published by D. Appleton & Co., New York. Text Book on Steam and Steam Engines, by A. Jamieson, is published by Charles Griffin & Company, London, England. The Mechanics of Machinery, by A. B. W. Kennedy, is published by Macmillan & Co., New York. Manual of Marine Engineering is published by D. Van Nostrand Company, New York. Practical Treatise on High-pressure Steam Boilers, by W. M. Barr, is published by Yohn Brothers, Indianapolis, Ind., and all the following works are published by John Wiley & Sons, New York: Indicator Practice and Steam Engine Economy, by F. F. Hemenway. Text Book on the Mechanics of Materials, and of Beams, Columns and Shafts; Treatise on Hydraulics; Roofs and Bridges; Graphic Statics; all by M. Merriman. Principles of Elementary Mechanics; Theory of the Construction of Bridges and Roofs, both by Prof. De Volson Wood. All these books are well known and can be obtained from any first-class dealer in scientific works.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

George B. Grant—Gear Wheels. See p. 20.

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"Twenty Years With the Indicator," by Thomas Pray, Jr. 10,100 sold. Price, $2.50. Order of bookseller; take no other.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

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Our catalogue of books on all subjects, including books for machinists and engineers, sent free. Norman W. Henley & Co., 150 Nassau St., N. Y.

Hyd. press, hyd. jacks, steam tables, accumulators, cutting and stamping dies for sheet metal, foot press, etc. S. Hartley, 245 N.J.R.R.Ave., Newark, N.J.

Hand-books for engineers: Reed's, $4.50; Haswell's $4.00; Roper's, $3.50; Hawkins', $2.50, all postpaid on receipt of price. Catalogue. Theo. Audel & Co., publishers, 91 Liberty Street, New York.

25″, 32″, 37″, 42″ — "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

DuBois & DuBois, Patent Attys., 715 11th St., Washington, D. C., procure first-class patents. Send stamp for illustrated pamphlet, "March of Invention," containing valuable information, and list of references.

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De Lamater Screw Propeller Wheel, made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

Club Rates.—If no one is getting up a club for the AMERICAN MACHINIST in your town or establishment, send for Circular of New Club Rates, and try it yourself. Address AMERICAN MACHINIST, 96 Fulton St., New York.

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. American Machinist Publishing Co., 96 Fulton St., New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 53 East Tenth Street, New York.

MANUFACTURES

According to rumor, Northern capitalists have decided to build a rolling mill at Norfolk, Va.

A. B. Patterson and others, of Chicago, Ill., are to build new frictionless metal works, at Chattanooga, Tenn.

The Taylor Furniture Company has been incorporated, at Taylor, Tex., with a capital stock of $5,000.

It is reported that the Ansonia Clock Company, now located in Brooklyn, N. Y., is to move back to Ansonia.

The new brass foundry of the Colton Manufacturing Company, at Montpelier, Vt., has been put in operation.

P. S. Frost & Co., of Boston, Mass., are to put into shape and operate the Pequoig Mill at Winchendon, Mass.

W. H. Bigsby, of New Braunfels, Texas, is negotiating for the removal of his woolen-mill to San Angelo, Texas.

The Southern Engine and Boiler Works Company, Jackson, Tenn., will build a new boiler house 65x100 feet in size.

The Homeland Pebble Phosphate Company, Homeland, Fla., will rebuild its phosphate works, recently burned.

Big Spring, Texas, has, it is stated, raised a bonus of $10,000, to secure the establishment of a woolen and scouring-mill.

Negotiations are in progress looking to the establishment of a knitting-mill at Tallapoosa, Ga., by New York parties.

Tim, Wallerstein & Co.'s shirt factory, at Greenwich, N. Y., which has been closed for a week, resumed work Monday.

J. Robinson, of Cleveland, Ohio, is investigating, with a view of establishing a sewing machine factory in Buchanan, Va.

The Columbia Iron and Steel Company, Uniontown, Pa., has settled all labor claims, and the plant is ready to start.

The Johnson Steel Rail Company, at Johnstown, Pa., have completed plans for a new machine shop and roll-mill, 365x50 feet.

A new water-works system is reported as to be constructed at Tybee, Ga., and the construction of a sewerage system is talked of.

It is reported that the Rome Cotton Tie and Manufacturing Company, at Rome, Ga., will double the capacity of their rolling-mill.

The organization of a co-operative manufacturing company, for the purpose of erecting a cotton-mill, is talked of at Belmont, Ala.

It is reported that extensive improvements in machinery are to be made at the Crescent and Weetamoe Mills, Fall River, Mass.

The citizens of Denver, Col., are negotiating with Pontefract Bros., of Bell's Landing, Penn., for the removal of their woolen-mill there.

The Emerson car heating apparatus will be manufactured at Springfield, Mass., by a company which has a capital of half a million.

There is talk of a new iron foundry at Henderson, Me., to make castings required for locomotives and cars on the Canadian Pacific Railroad.

The new machine shop of the Limerock Railroad Company, of Rockland, Me., has been completed, and is now ready for business.

The Richmond & Danville Railroad Company (office, Richmond, Va.,) will, it is reported, put new machinery in its repair shops at Macon, Ga.

It is stated that the people of Walker County, Ga., raised $100,000 in two days for the erection of a cotton factory at Lafayette, in that State.

The Dalton Machine Company, of Dalton, Mass., have just completed a new foundry building, and now have an admirable outfit for their work.

A $10,000 stock company has, it is reported, been organized at Pine Bluff, Ark., for the purpose of erecting an ice factory with a daily capacity of 10 tons.

The Belvidere, N. J., iron mines have been leased by the Thomas Iron Company, of Hokendauqua, Pa., who will erect machinery and operate the mines.

The Hanover Machine Works have been organized, with a capital stock of $100,000, at Frederick, Md., for the purpose of manufacturing machinery.

The Cambria Iron Company, of Johnstown, Pa., contemplates rebuilding the wire works destroyed by flood. They will cost $1,000,000, and will employ 500 men.

R. H. Thatcher and others are organizing a stock company to erect and operate an ice factory of 15 or 20 tons capacity at Donaldsonville, Ascension Parish, La.

The Beach Manufacturing Company, of Hartford, Conn., have decided to abandon their works in that city, and to remove their entire plant to Beacon Falls, Conn.

A movement is said to be on foot at Dubuque, Iowa, to organize a company to take the place of the Iowa Iron Works, when that concern moves to St. Louis, Mo.

The Automatic Valve Company has been incorporated for the purpose of manufacturing and dealing in automatic valves under patent rights at Louisville, Ky.

The Spottswood Land and Mining Company has been incorporated, to manufacture lumber, deal in mines, etc., at Spottswood, Va. The capital stock is $300,000.

The Sigourney Tool Company, of Hartford, Conn., have recently added a section 85x32 feet, two stories high, of brick, to their shops, and will put in new machinery.

Day & Morse, of Rockland, Me., have just completed a new machine shop at that place, and are to add new machinery. They will do the repairs of the Limerock Railroad.

Thomas Ott, of Philadelphia, Pa., has, it is reported, contracted with the Cedartown Land Improvement Company to remove his woodworking factory to Cedartown, Ga.

The Farmers & Merchants' Oil and Guano Company has been incorporated for the purpose of establishing a fertilizer factory and cottonseed-oil-mill at Fort Gaines, Ga.

The Pee Dee Iron Works has been organized, with a capital stock of $40,000, for the purpose of manufacturing stoves, cotton presses, engines, agricultural implements, etc., at Darlington, S. C.

The Highland Park Manufacturing Company, of Charlotte, N. C., recently incorporated, will erect a gingham-mill at Charlotte. R. H. Jordan, is president, and Gilmer Brinizer, treasurer.

The New Process Rawhide Company, Syracuse, N. Y., continue to receive commendatory letters from those using their rawhide pinions. This is particularly true of electric railway companies.

The Diamond Clamp and Flask Works, Richmond, Ind., has issued a circular with cut and price list of rapping plates, drawing irons and other molders' supplies of which this company make a specialty.

The Alabama Midland Railway Company has, it is reported, purchased the Montgomery, Ala., repair shops of the Louisville & Nashville Railroad Co. (office, Louisville, Ky.) and will operate same.

De Soto Machine Company has been formed at De Soto, Mo.; capital, $9,000. Incorporators: Nicholas O'Brien, John Pickels and John H. Williams.

The works of the Chicago Axe Company, of Hammond, Ind., have been bought by Peoria (Ill.) capitalists. The purchasers, it is said, will spend $100,000 in enlarging the plant, and employ 600 men.

It is reported that the Savannah, Florida & Western Railroad Company will expend from $150,000 to $200,000 in building warehouses, tracks and elevators in Savannah, Ga., for handling phosphate rock.

Springfield, Ill., has granted a franchise for an electric light plant to the Citizens' Light and Power Company, which is to furnish the city with 2,000 c. p. arc lights at the rate of $75 per year per light.

A number of capitalists have, it is reported, purchased a tract of phosphate land at Bowling Green, Fla., from Mr. Peeples, and will organize a stock company to develop same and erect phosphate works.

The Powell Wire Nail Machine Company, of Cleveland, were incorporated by Stevenson Burke, E. J. Ingersoll, E. T. Ives, D. A. Dangler, W. J. White, R. Powell and H. C. Emison; capital stock, $250,000.

The J. R. Montgomery Company, of Windsor Locks, Conn., are building a new mill to contain 15,000 spindles, for fine yarns to spin from thirties to seventies. The building is to be five stories high and 125x76 feet.

H. M. Atkinson, H. E. W. Palmer, W. R. Joyner and others, have incorporated the Georgia Electric Light Company at Atlanta, Ga., for the purpose of operating an electric light plant, etc. The capital stock is $600,000.

J. F. Walton, J. S. Neave and Charles Neave have incorporated the Walton Iron Company for the purpose of manufacturing iron. The authorized capital stock is $75,000; principal place of business in Covington, Ky.

The Sovereign Lubricating Company, of Waukegan, Ill., has been incorporated, for the manufacture of lubricating oils. The capital stock is $50,000, and the incorporators are W. J. Allen, H. W. Kent and G. E. Fuller.

It is stated that the location of the headquarters of the Richmond & West Point Terminal Railway & Warehouse Company, in Atlanta, Ga., will insure the establishment there of car and locomotive works and repair shops.

The Duquesne Tube Works Company, which recently erected large additions to its plant at Duquesne, Pa., has decided to increase the capital stock from $100,000 to $150,000, and will shortly add a rolling-mill to its capacity.

The Courtableau River Mills, Limited, recently organized to erect a cotton-mill at Washington, La., has a capital stock of $75,000, and, having received its machinery, will at once commence the erection of building for same.

The Log Mountain Coal, Coke and Timber Company have been incorporated, at Pineville, Ky., for the purpose of building iron furnaces, coke ovens, developing mineral lands, etc. The authorized capital stock is $2,000,000.

The Colorado Coal and Iron Company's Bessemer works, at Pueblo, Col., will be running in full blast by August 15, it is expected. A large amount of money has been spent in improvements at the works during the past six months.

The Holt Improved Water Filtering Company has been incorporated, to manufacture and deal in improved water filters, etc., at Richmond, Va. J. A. Morris is president, R. A. Wilkinson, vice-president, and J. L. Capston, secretary.

The Jonesboro Immigration and Improvement Association has been organized with J. H. Kitchens, president, and A. L. Krewson, secretary, for the purpose of promoting the establishment of manufacturing industries, etc., in Jonesboro, Ark.

Jones Scale Works, at Binghamton, N. Y., are being enlarged by the addition of another story to the main building, and the building of a foundry 160x60 feet, a forge shop 60x40 feet, a boiler and engine-room 60x50 feet and a storehouse 75x60 feet.

The Hercules Foundry Company, incorporated in Massachusetts with A. L. Rand, president, and O. B. Cole, treasurer, has recently purchased, and will complete the iron foundry of the Pike Manufacturing Company in course of erection at Pell City, Ala.

Jones & Mack, 220 Walnut street, Cincinnati, Ohio, have issued a new circular of their I. X. L. drawing table. The little circular gives reasons why this table is useful, and it contains information outside the regular business of selling drawing tables.

The works of the Keystone Cotton Tie Company, and the Iron and Steel Band Company, at Mendelsohn, Pa., the new town recently developed near McKeesport, are nearly finished, and will soon be in operation. They will give employment to a large number of men.

The recent purchasers of the Battersea cotton-mill at Petersburg, Va., have incorporated the Pocahontas Mills Company with W. D. Phillips, president, and will improve and put the mill in operation. The capital stock is $40,000, with the privelege of increasing to $100,000.

The Virginia Construction Company, Norfolk, Va., has been granted a charter to engage in mechanical and engineering work. G. W. Goddard, of Roanoke, is president, and Thomas Lancaster, of Norfolk, secretary; capital stock to be not less than $20,000, nor more than $50,000.

The Cedar Mountain Steel Company was recently organized at Knoxville, Tenn. The company has bought twenty acres of brown hematite iron ore on the Doe River, five miles above Elizabethton, and will immediately put up a thirty-ton blast furnace to make steel ingots by the Canby direct process.

The Joliet Enterprise Company, of Joliet, Ill., whose wire drawing and barb wire works were destroyed by fire a short time since, have decided to rebuild in South Joliet. They propose to erect a rod-mill, as well as a wire drawing plant and a barb wire factory.

The work on the Nemasket Mill, now building at East Taunton, Mass., is progressing so favorably that the managers are in hopes to get at work by the first of next April. Thus far there have been no hitches in the building process, and the foundation is all in excepting that portion where the wheels are to be placed.

The McKenney Machine Company, of Baltimore, Md., which has recently arranged for the new machine shop at Sequachee, Tenn., has already started a force of men therein, and will soon increase it. They make a specialty of sewing machines, and will make an effort to try and supply much of the Southern trade.

The Curran Oil-saving Bearing Company, of Chicago, has been incorporated, with capital stock of $100,000. The company will manufacture an oil-saving bearing for car journals and other machinery. Wm. Curran, R. T. Bertelsen, Herman Lorenz, August C. Glover and Friedrich Roehl are the stockholders of the company.

The Malden Water Motor Company has been organized at Providence, R. I., under a Maine charter, with F. W. Sawyer, president; C. T. Small, of Malden, Mass., treasurer, and John T. Vinal, of Providence, general manager. The company proposes to purchase the G. M. Cruickshank engine works, and to manufacture motors there.

In London, Eng., the Anglo-American Trust Corporation, Limited, of London, has been organized recently by J. S. Wallace, of Kent; C. T. Russell, of London; A. G. Berkeley, of London, and others, with a capital stock of £105,000. Its purposes are, among others, to endeavor to secure the removal of English manufacturing plants to Tallapoosa, Ga.

It is said that an English syndicate has purchased practically all the leather-board factories in the Eastern States. The purchase includes the plant of the Harwood Manufacturing Company, at Leominster, Mass; the Moncan Manufacturing Company, Kennebec; the Leatheroud Company, of Boston, and Clegg & Fisher, of Lawrence. The local managers are to remain in charge.

It is stated that the Hopedale Machine Company, Hopedale, Mass., will enlarge its works immediately by building two three-story buildings, one of brick, 80x50, between the wooden machine shop and the setting-up shop, looking toward Freedom street. The other will be of wood, 160x100, extending from the new brick shop to Freedom street, and from Hopedale street to the back side of the setting-up shop.

A charter has been issued to the Birmingham Iron and Steel Company, of Pittsburgh, with a capital stock of $50,000. The incorporators are W. H. Williams, J. C. Williams, Charles Large and T. M. Thomson. The new concern proposes to erect an open-hearth steel plant at Kensington, on the line of the Allegheny Valley Railroad, about 20 miles from Pittsburgh. Work on the plant will probably be commenced in a short time.

The Wrought Steel Wheel Company has been incorporated, with a capital stock of $2,000,000, by William P. Shinn, of Pittsburgh, Pa.; Smith M. Weed, George W. Bentley, Edward A. Smith and Nicholas W. Nivan, of New York, and James W. Roach, of Camden, N. J. The company will manufacture wrought solid steel car wheels for railroad use. Mr. Shinn will be president of the company, and Gen. William F. Smith, of Philadelphia, treasurer.

The Ongley Electric Company's System is, we are informed, meeting with success; the public have recognized the value of their reliable watchman's register, which faithfully records the movements of a night or day watchman, and its many adjuncts, viz., engine-stopping device, fire alarm signals, automatic sprinkler protector, etc., etc. Among the latest establishments which have been equipped with this system are the Pennsylvania Railroad yards both at Jersey City and Hoboken; Eble & Herter's brewery, Philadelphia, Penn., and the Appleton Manufacturing Company, of Brooklyn. We are also informed that many other large concerns have just closed contracts with the company. The company is located at No. 1 Broadway, New York.

The Ferracute Machine Company, of Bridgeton, N. J., have just built a new erecting shop, and are adding considerable new machinery to their plant. They have put in two large planers, a radial drilling machine, large boring mill, two drill presses, milling machine, etc. They are also building an electrical crane for their erecting shop. Their business is increasing constantly, and they have just gotten up patterns for two or three new lines of presses, one line of power cutting presses being for general sheet metal work, another line of foot presses of entirely new design, and a third line of double-action or drawing presses. They are also building some very heavy presses adapted for punching and shearing girders, bridge work, etc. They have recently issued some new catalogues describing their machinery.

The St. Louis Iron and Machine Works are doing a big business, which is increasing in its demands every year. Considerable additions have been made to the original plant, with a design to secure space, light, and every modern facility for handling machinery. Their specialties include Corliss engines, patent Lion brick presses, ice machinery plants, etc. Some 200 hands are employed in these works, which date back to 1854. About 25 lathes are employed in these works, among which is a pit lathe capable of turning a 30-foot pulley and a 6-foot face. There are three traveling cranes, capable of a load of 20 tons each, and every appliance that money can secure, or ingenuity devise, is being adopted in this establishment, to meet any demand made on their means of manufacture. The progenitor of this representative institution is a remarkable example of industry, persistence and success. In the fifties the plant represented $200; to-day its value is in excess of $300,000.—*Age of Steel.*

The following will explain itself: Lexington, May 26th, 1891.—I have this day sold to Frank Burgess the part of my business heretofore carried on in Boston, at 31 Hartford street, and known as The Boston Gear Works. The sale includes the tools and stock used in the business, and the good-will and name of the establishment, and I will request such of my customers and friends as have been in the habit of sending me their business favors at that address to continue the same to my successor. Mr. Burgess has been in my employ for the past nine years, for the past three as superintendent, and his employes have many of them been with me for from three to seven years. I shall continue the general gear business at this place, paying particular attention to iron list gearing, iron gear cutting and jobbing, bevel gearing with planed teeth, and specialties in gearing. GEORGE B. GRANT, The Lexington Gear Works, Lexington, Mass... 31 Hartford street, Boston, Mass. GENTLEMEN: We wish to inform our patrons that the business of the Boston Gear Works, formerly owned by George B. Grant, was sold, May 26th, 1891, to Frank Burgess, the former superintendent, who will succeed Mr. Grant as proprietor of the above works. Accept our thanks for all past patronage. With skilled workmen and superior facilities for furnishing and cutting gear wheels of every description, and with special facilities for the manufacturing of brass gearing, we propose to give all our patrons entire satisfaction in regard to the quality of the work done, as well as the charges for same, and with this in view, we would solicit your further orders. Yours respectfully, THE BOSTON GEAR WORKS.

Wood that Resists Fire.

In a recent Western fire it was again demonstrated in the clearest manner possible that California redwood, as a building material, comes nearer being fireproof than almost any other material of which buildings are constructed. In this instance a fire broke out in the upper part of a one-story building while the wind was blowing a gale that was recorded at the United States signal station as moving at the average rate of thirty miles an hour. But notwithstanding this, and the fact that it was several minutes before water was got to the building, the fir laths under the plaster were burned downward nearly to the floor, and whole squares of the side plastering were thus loosened and fell in before the fire had burned through the thin redwood shingle roof.

It was a most wonderful illustration of the fire-resisting qualities of redwood. Had the whole building been as combustible as the laths, nothing could have saved the city. The roof was old, and as thoroughly ready for the flames as redwood ever becomes, yet the fact remains that it resisted the ignition, and bystanders could see a seething furnace of flames through the apertures under the eaves, while nothing but smoke issued through the roof. The peculiar manner in which redwood smothers flame, and prevents its flashing forth, is an important fact in suppressing conflagrations, as fires are communicated to neighboring buildings by means of the external flames and sparks which they send up.—*Chicago News.*

A Boulder, Col., dispatch says that another rich find of silver is reported on Pomeroy Mountain, near Caribou. The vein is about three inches thick and of pure metal. It is evident that there exists a still larger vein somewhere in the vicinity, of the same kind of mineral, and it is thought these discoveries will soon lead to developments that will cast in the shade even the wonderful mines of Nevada.

Double-geared Shaper.

The illustration represents a double-geared shaper in which simplicity of construction, convenience of handling, strength and durability are some of the marked features. A new departure is found in the double gearing, consisting of two racks, one on each side of the center of cutter-bar, operated by two rack-wheels and a double pinion. It is claimed that this arrangement gives great power, a steady stroke, and that it equalizes the strain of cut, by applying the power direct, on each side of the tool. The shifting belt principle, on which this machine is operated, secures a uniform motion throughout the stroke. The stroke is reversed by the use of dogs, fastened on the ram, and is adjustable while the machine is in motion. By the use of large wheels and small pinions, a high speed for the driving shaft is obtained; this, in connection with the shifting device, enables the belt to move easily and quickly. For key-seating purposes, an opening is left under the ram, to admit a shaft 3½ inches diameter, through the frame.

The tool head is made to swivel, and graduated to plane angles. The screws, studs and shafts are made of steel, with long bearings. The vertical movement of rail is operated by bevel gears and screw inside of frame, protected from dirt and injury. An automatic cross feed to table is provided.

The box table can be removed, and the work bolted to the slotted apron. This is desirable when planing the tops and sides of heavy pieces.

With the adjustable friction feeding device, the feed can be varied from fine to coarse, and changed quickly without stopping the machine; it is also so arranged that the feed will take place at either end of the cut.

The swivel chuck has a graduated base, steel-faced jaws, which open to 8½ inches; they are 2 inches deep, and 12½ inches wide. The swivel chuck can be set to any angle, and is securely held at right angles by a tapered wedge. The shaper has a stroke of 24 inches, with quick return; the cross motion of table is 26 inches; vertical adjustment, 18 inches; the tool block has 8 inches of feed. When the ram is at the end of 24-inch stroke it has a bearing in column slides of 27 inches. Countershaft has two changes of speed; tight and loose pulley, 10 inches in diameter. The speed of countershaft should be 275 revolutions per minute for cast-iron, and 185 revolutions for steel. Weight of the machine is 2,200 pounds. It is manufactured by Messrs. Smith & Mills, 48 and 50 Central avenue, Cincinnati, O.; J. J. McCabe, 68 Cortlandt street, is the New York agent.

According to the report of the Commissioner of Patents, the following business was transacted during the year ending July 1, 1891: Applications for letters patent, 39,696; applications for design patents, 1,146; applications for reissue patents, 111; applications for registration of trade marks, 1,855; applications for registration of labels, 808; caveats, 2,333. Total, 45,949.

There were during the same period 25,307 patents granted, 1,744 trade marks registered, and 289 labels registered. The receipts from all sources aggregated $1,302,794, and the expenditures $1,145,502. The total balance in the treasury to the credit of the patent fund was, on July 1, 1891, $3,947,847. Mr. Mitchell makes an urgent appeal for additional room, and for increased salaries for the principal examiners of the bureau.

We have previously referred to the trouble the free miners in Tennessee are giving the State, owing to the fact that convicts are rented out to work in the mines. An extra session of the legislature will meet on Aug. 31, when this matter will come up for consideration.

The decision of Chancellor McGill, of New Jersey, that legal advertisements and other documents published in that State in any other than the English language are invalid, commends itself by its common sense.

Compound Engines.

BY JAMES TRIBE.

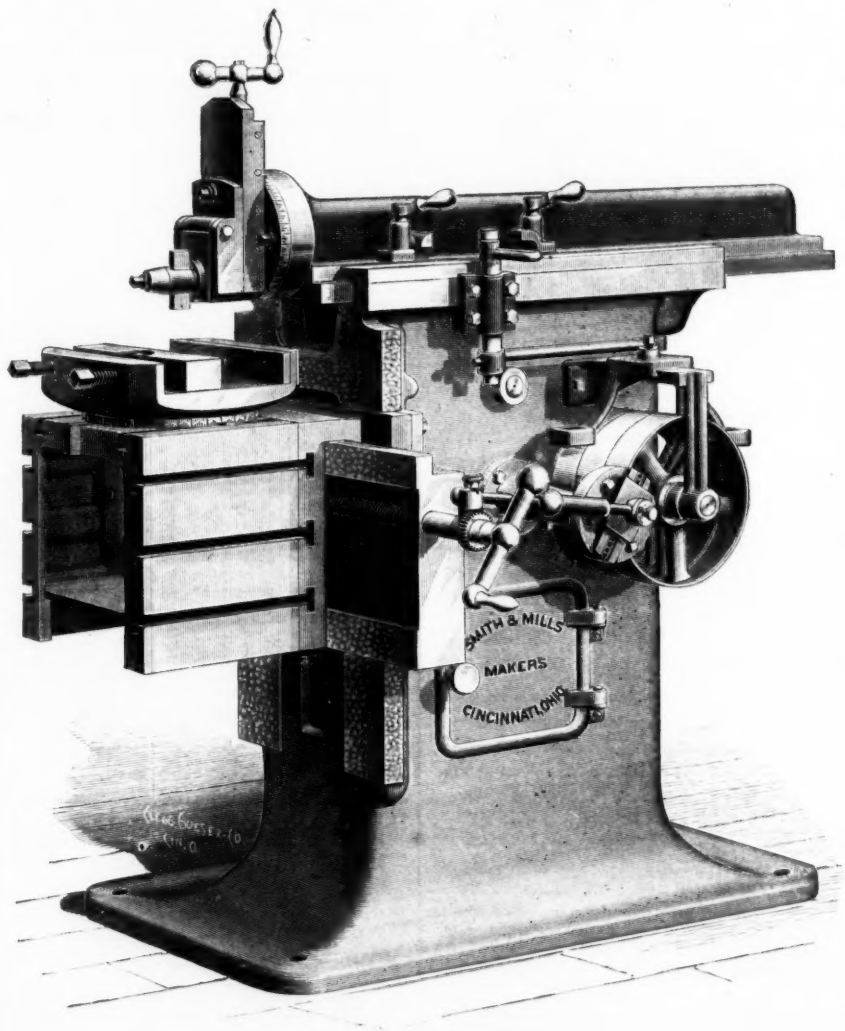
FIRST PAPER.

INTRODUCTION.

As an introduction to other articles which I propose to write for the AMERICAN MACHINIST, I desire to make a few general remarks.

The old proverb is, "Better to be wise and not seem so, than to seem wise and not be so." I do not desire in the least to intimate that I am able to deal with the subject of compound engines with absolute certainty, or that all my conclusions are in the strictest sense correct. The subject, at its best, is at the present time only in its infancy, and, like all other questions before the mechanical world, there is wide difference of opinion.

I shall, however, attempt to make clear certain facts which have come across my path from time to time, and which, by observation and actual experience, I have found to be of value in my efforts to comprehend the principles of compounding.



DOUBLE-GEARED SHAPER.

In order to carry out my purpose, I shall find it necessary to make some tables, rules and diagrams, which I hope will be useful to any who may endeavor to follow me in my reasoning. But I promise to avoid, just so far as possible, any unnecessary algebraic calculations, which I fear in many instances do not help, but rather hinder the average seeker after facts of real practical value.

Many good rules lose their value by their complex character; though perhaps nothing is included but can be rightfully claimed for their accuracy. But for all practical purposes, many of the minor points may to advantage be omitted, and the consequent simplicity will add very much to their usefulness.

VARYING CONDITIONS.

Nearly every steam plant has a set of conditions, peculiar to itself, and which, in consequence of surrounding circumstances, have become almost unalterable. These conditions may or may not be favorable to what may be considered, in a general way, the best type of engine for economy, but may require one designed expressly to suit the conditions, and at the same time to give the most economical results under such circumstances or conditions.

For instance, in one case the boilers may have been in use in connection with some old style engine, and designed to carry only low-pressure steam of, say, 50 or 60 pounds; while in another they may be capable of 160 or 170 pounds. Now, under these two different conditions the proportions of the cylinders for a compound engine should be very different, which I will explain later.

In another case there may be no means of supplying the necessary injection water for condensing purposes, and consequently a non-condensing compound may be the proper thing. Again, not only may it be found necessary to design a non-condensing engine, but, as in some instances, the low-pressure cylinder may have to exhaust against a back pressure of several pounds above the atmosphere.

Before calculating the relative areas of the cylinders for a compound engine, the exact conditions should be ascertained and taken into account, as the sizes necessary for the required power should be figured more closely for a two-cylinder engine than for a single cylinder, and still more closely for a triple or three cylinder than for a two-cylinder engine.

If the exact required horse-power can be ascertained, and the proportions figured accordingly, the result will be more likely to be good than they would if designed without a proper knowledge of the conditions.

The questions which naturally suggest themselves in the investigation might be well put in the following order:

1. Horse-power required.
2. Number of revolutions per minute.
3. Pressure of steam in the engine-room.
4. Condensing or non-condensing.
5. Number of cylinders preferred.

A little study over the results of this inquiry will soon lead the competent designer to decide upon the best type of engine to suit the circumstances, and to select such rules and formulas for proportions of the parts, relative cylinder areas, etc., as are likely to give the best and most economical results.

I wish to suggest, here, that while rules are of great importance, and, in fact, are almost indispensable, when made and tested be actual experience and practice, yet, unless a judicious application of them be made, the lack being through perhaps want of knowledge of the circumstances, or inability from want of experience, serious error, or possibly disaster, may be the result. Common sense, therefore, and a general knowledge of the natural laws that relate to steam, heat, condensation, evaporation, etc., together with such rules and formulas as have been made and tested, is of the greatest importance.

A correspondent of *Notes and Queries* has this to say about a noted expression: "Our naval squadron in the Chinese waters was engaged in bombarding the forts of Taku. A squadron of vessels of the United States navy was at that time cruising off the same coast. The United States were neutrals. The captain of one of their frigates had occasion to visit the commander of a British line-of-battle ship. At the moment of his official call he found the latter hotly engaged with the land batteries. He left his gig alongside the fighting-ship, with his boat's crew in charge of her, while he went on board, and was conducted to the captain's cabin. When, on the termination of his visit, he resought his boat, he found her attached to the ship's side by her painter, but tenantless. The story goes that, searching for his boat's crew, he found them among the smoke on the fighting deck of the man of-war, stripped to the waist, and helping the British Jack Tars to work the guns. The American captain was naturally very angry, for such a situation might have led his government into serious complications with the Chinese Empire; but when he warmly remonstrated with the coxswain of his cutter, that official, it is said, as he saluted, offered the now historical apology, 'Arter all, sir, blood's thicker than water!'"

Machinists' Supplies and Iron.

NEW YORK, August 15, 1891.

Iron—American Pig—Business is slow, with no particular change in prices.

We quote: No. 1 Foundry, Standard Northern brands, $16.50 to $17; No. 2 is selling at $15 to $15.50, and Gray Forge at $13.90 to $15. Southern brands of good quality are obtainable at $16 to $17.50 for No. 1 Foundry; and $15.75 to $16 for No. 2; and $14 to $14.50 for No. 3.

Scotch Pig—We quote at $23 for Coltness, and $20.50 for Eglington.

Copper—Lake Copper values are still unsettled, and depend in a large measure on foreign quotations, which are lower, notwithstanding a strong European effort to support prices. The local market nominally quoted at 12.10c. to 12.15c.; some holders demand 12 20c. Arizona Copper is quoted at 12c. to 12½c. Casting Copper is scarce at 11¾c. to 12c., according to holder.

Lead—The Pig Lead market continues firm at 4.55c. asked for either spot or future, but business is very dull, as buyers are disposed to postpone wants until the market favors them.

Spelter—The market is dull at figures 5c. to 5.05c. for New York delivery.

Tin—The market is easier, as offerings are more liberal at 20c. Speculative interest is quiet.

Antimony—The local market is about steady.

We quote 11c. for Hallett's; 13c. for Cookson's, and 11¾c. for L. X.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 90 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

A first-class mechanical draftsman desires engagement. Address B. T., AM. MACHINIST.

Mechanical draftsman, good designer, wants situation. Address Box 41, AM MACHINIST.

Wanted—A first-class machinist for general work. Address E. C. Wehrfritz, Little Rock, Ark.

A thor'ly comp't designer and draftsman on machine tools and special mach'y, wants posi'n; can estimate and take charge. M. E., AM. MACHINIST.

Wanted—A foreman pattern maker with general experience. Address, giving references, Birmingham Iron Foundry, Birmingham, Conn.

Wanted—To correspond with machine firms in need of foreman or superintendent for their shops. Address P. L., AMERICAN MACHINIST.

Wanted—Mechanical engineer acquainted with engine business, as salesman; state age, experience, and salary required. W., AM. MACHINIST.

Position as supt. or manager in a mfg. establishment, varied prac. exp. in important positions; fully up in duplicate mfr. Box 39, AM. MACHINIST.

Wanted—By a sober, competent young man, position as pattern shop foreman for some manufacturing concern; refs. furnished. Z., AM. MACHINIST.

Wanted—A first-class blacksmith to take charge of shop doing marine eng. and car work. The Harlan & Hollingsworth Co., Wilmington, Delaware

Spanish correspondent desires position; formerly engaged in S. American trade; N. Y. refs. Address Correspondent, Ivor, Virginia.

Thorough young mechanic, first-class draftsman, desires position in drawing-room; large experience on machine tools. Address F. E., AM. MACHINIST.

Advertiser is experienced in devising tools and methods for economical manufacture, and wants position. BOX 42, AMERICAN MACHINIST.

Sup't wanted for shop manufacturing machine bolts; must be a good mechanic, and thoroughly accustomed to handling men. Address, stating age, exp., and refs., M., B. & Co., Box AM. MACHINIST.

Mechanic of extensive exp. and ack'd ability, accus'd to supervision of work and management of men, good designer and draftsman, desires a responsible position after Sept. 1st. BOX 43, AM. MACHINIST.

Machinist who is accustomed to high grade automatic engine work, simple and compound, and the use of indicator, is an experienced outside erector, and fair draftsman, desires employment; satisfactory reasons. BOX 38, AM. MACHINIST.

Draftsman, technical graduate, 6 years' exp. as machinist and tool maker, 7 as draftsman and designer of general, special and hydraulic machinery, seeks permanent engagement in N. Y. City or vicinity from Sept.; references. BOX 30, AM. MACHINIST.

Wanted—A competent salesman for the machinists' tool and supply trade; preference given to those having an established trade. State salary expected and approximate of sales per annum. H. E. Rogers, Box 879, N. Y. City.

Wanted—Supt. for a machine shop near New York; an energetic, systematic man with a technical and practical education, and a thorough knowledge of the requirements of interchangeable work will find an excellent opening. Address in writing, stating exp. and refs., X. Y. Z., AM. MACHINIST.

Foreman Pattern Maker—Situation wanted. Have had experience in fine sewing machine, light machinery, and electrical pattern making in wood and metal; have acted in capacity of foreman for a number of years; can come well recommended. Address Pattern Maker, AMERICAN MACHINIST.

Wanted—Position by thoroughly prac. mechanic as general foreman or asst. superintendent; well up in modern mach. shop practice, and thoroughly well up in all kinds of engine work, and pumping and hydraulic machinery; best of references; have held above position with first-class firms. Address Howard, AMERICAN MACHINIST.

Wanted—A first-class brass finisher to take the position of foreman in a large shop, where every description of engineers' and plumbers' brass work is manufactured; men competent in every respect to fill the position only need apply. Apply by letter addressed "T" to the AM. MACHINIST, and state experience, and salary expected.

Wanted—Expert bookkeeper and accountant for an establishment doing a general foundry and machine business, and dealing in machinists' supplies; must be experienced in those lines, and posted on prices; also want a stenographer and typewriter. State age, experience, references, and salary expected. Beall Machine Works, Cumberland, Md.

✣ MISCELLANEOUS WANTS ✣

Advertisements will be inserted under this head at 35 cents per line, each insertion.

Cheap 2d hd-lathes & planers. S. M. York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Light and fine machinery to order; Foot Lathe Catalogue for stamp. E. O. Chase, Newark, N. J.

Best Bolt Header in the world for $50. Address C. H. Baush & Sons, Holyoke, Mass.

Wanted—Specialties to build for the Southern trade. Bluefield Iron Works, Bluefield, W. Va.

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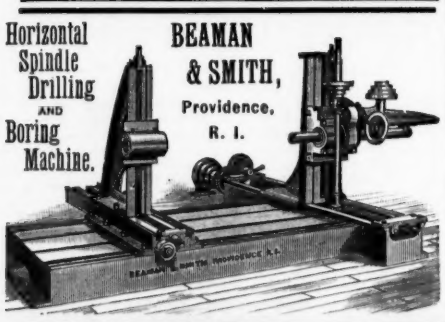

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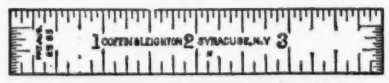

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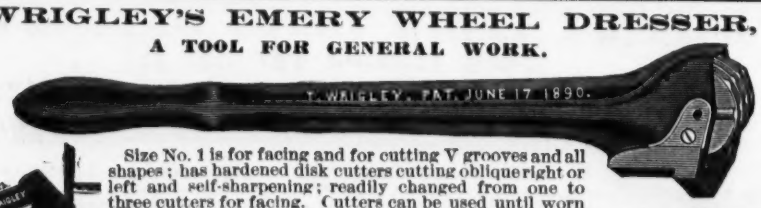

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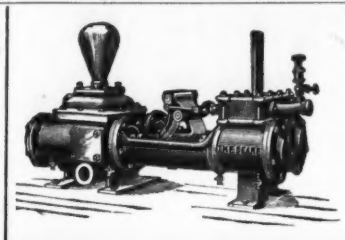

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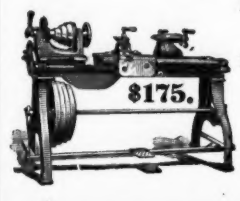

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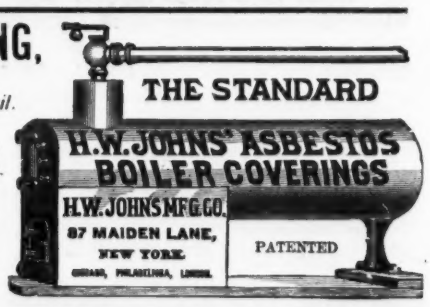

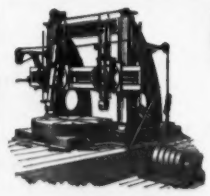

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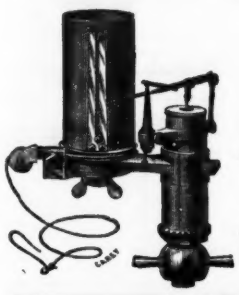

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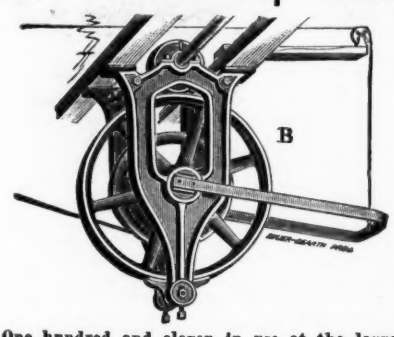

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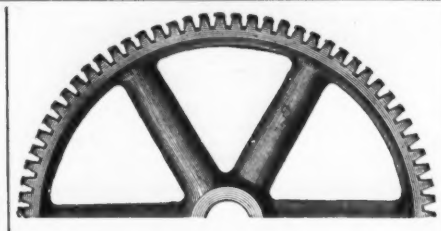

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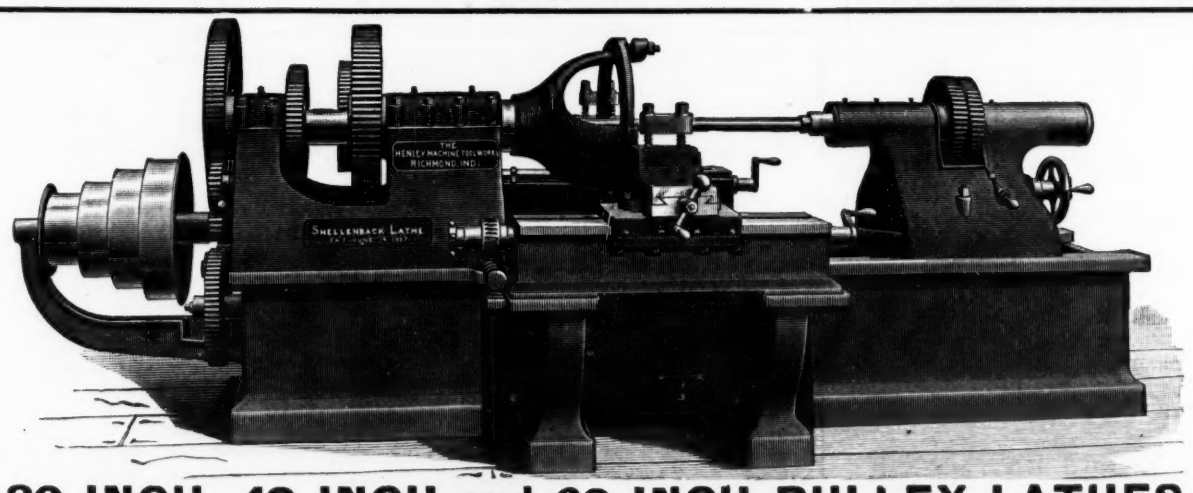

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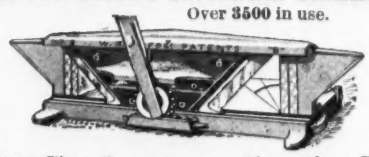

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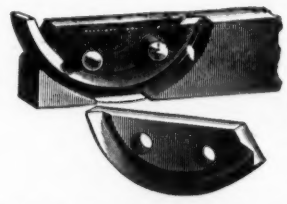

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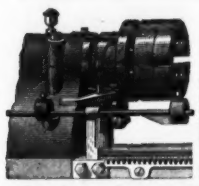
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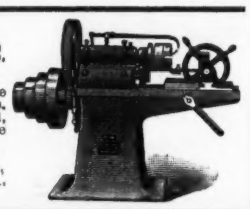

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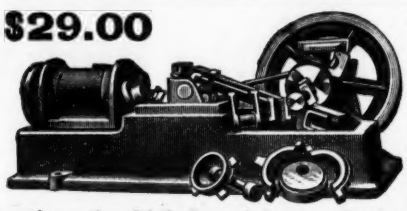
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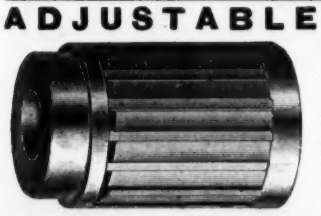
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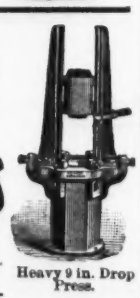
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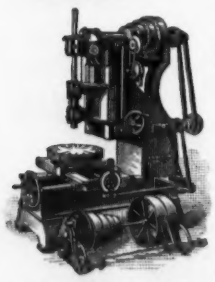
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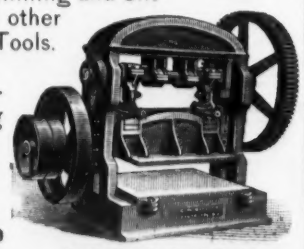
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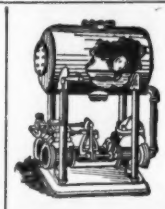
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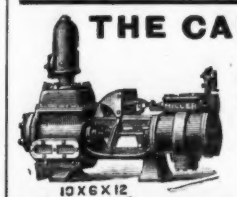
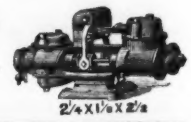

10 X 6 X 12

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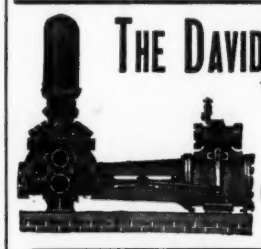
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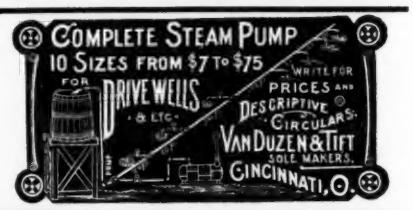
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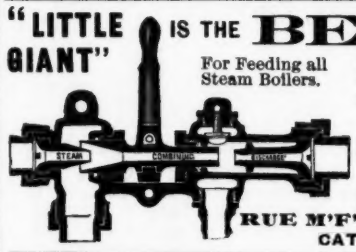
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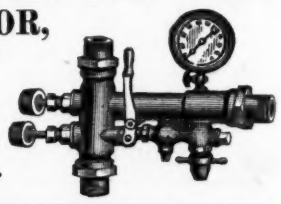
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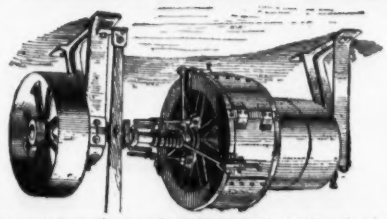
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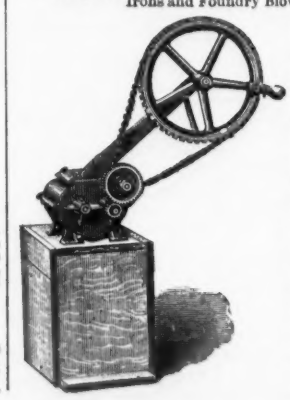
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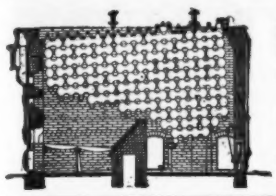

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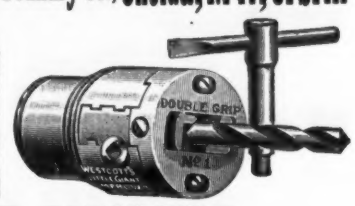

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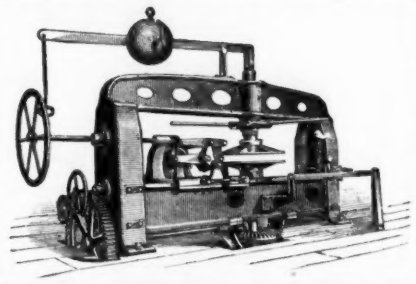

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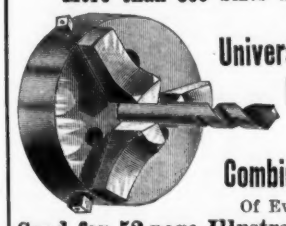

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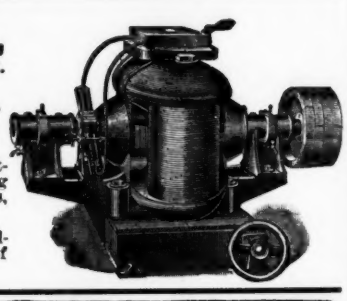

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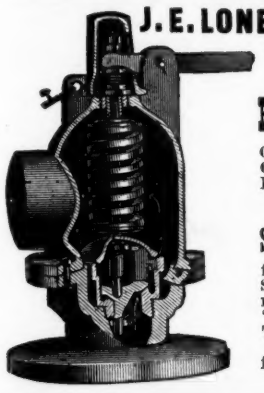

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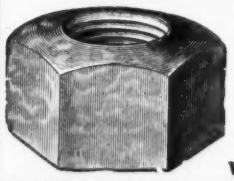

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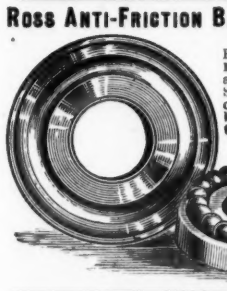

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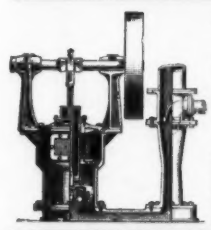

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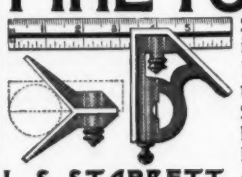

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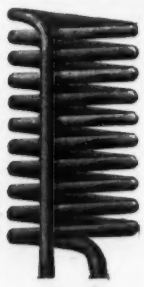

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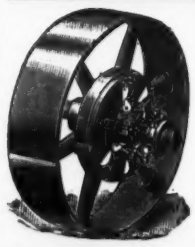

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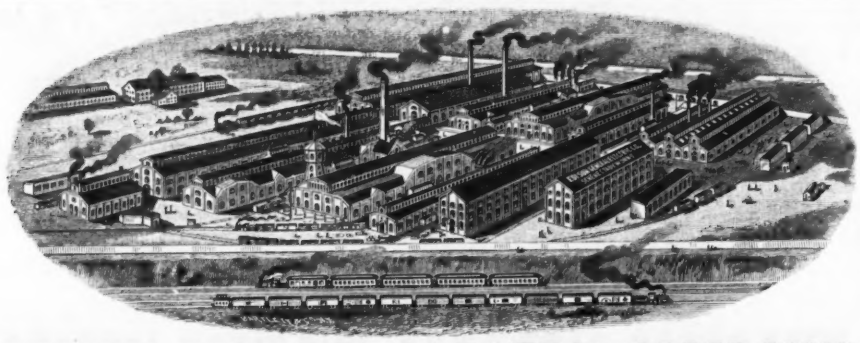

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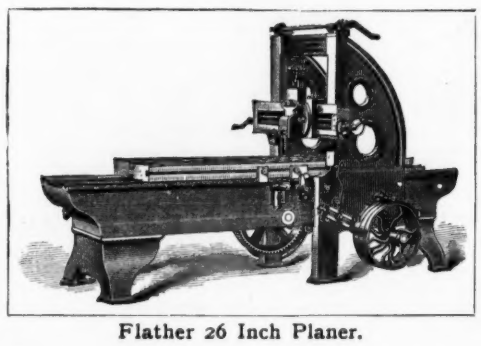

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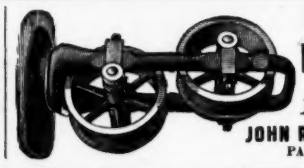

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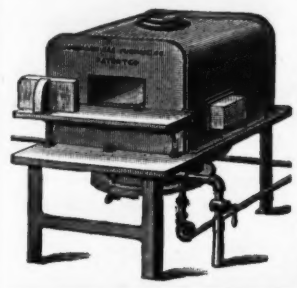

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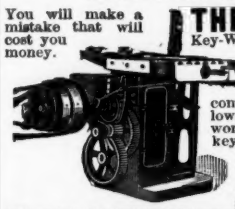

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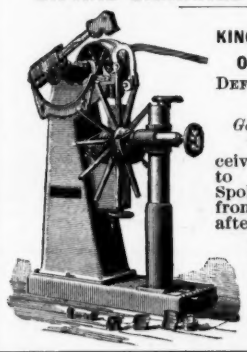

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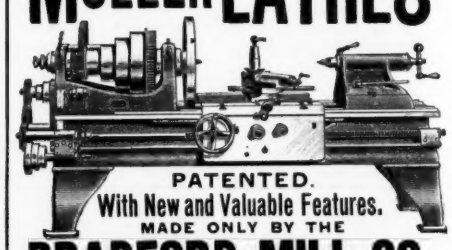

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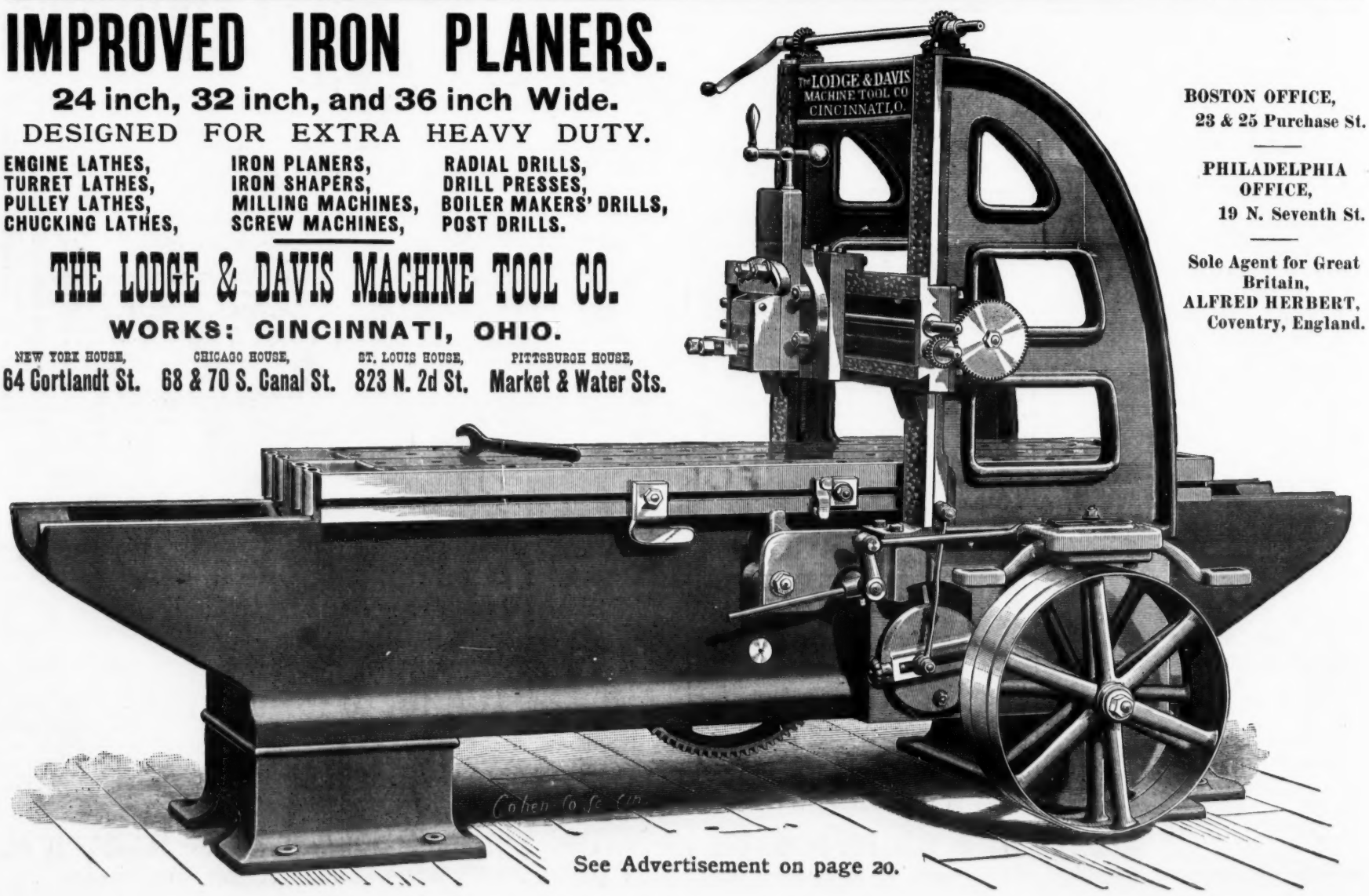

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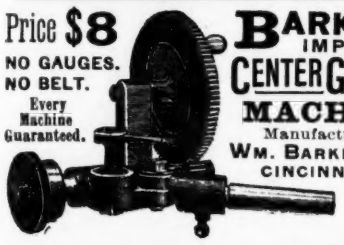

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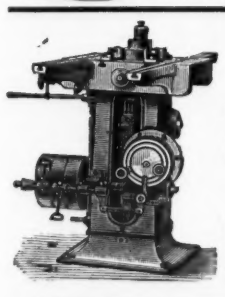

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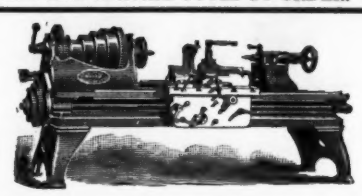

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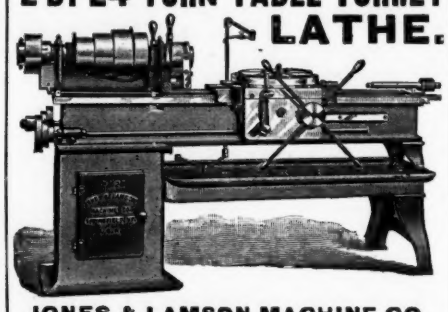

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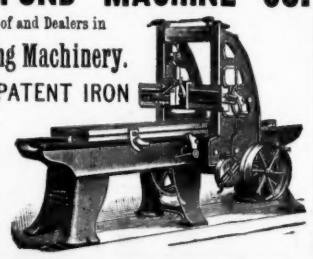

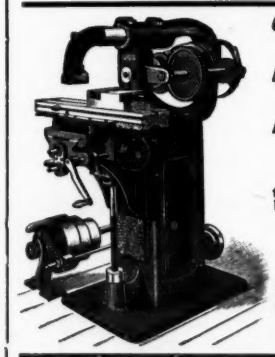

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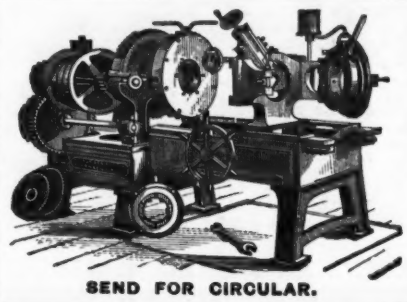

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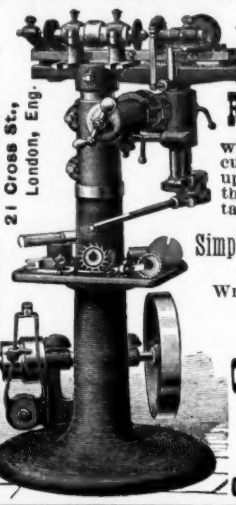

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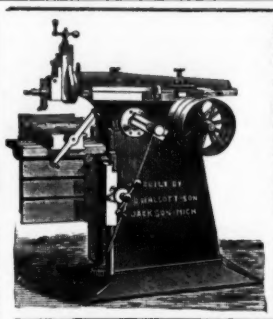

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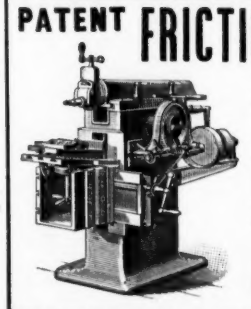

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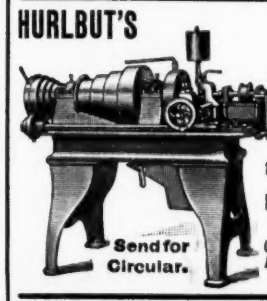

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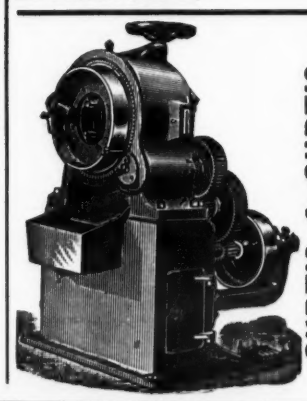

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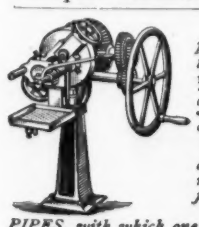

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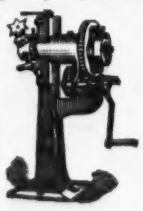

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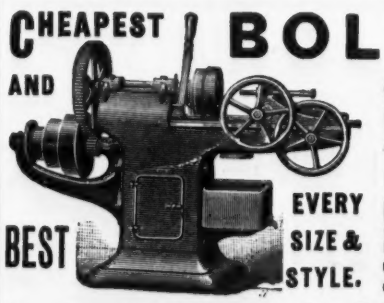

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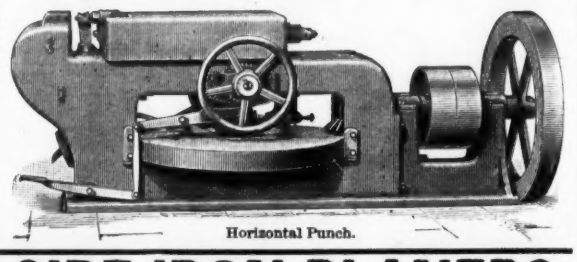
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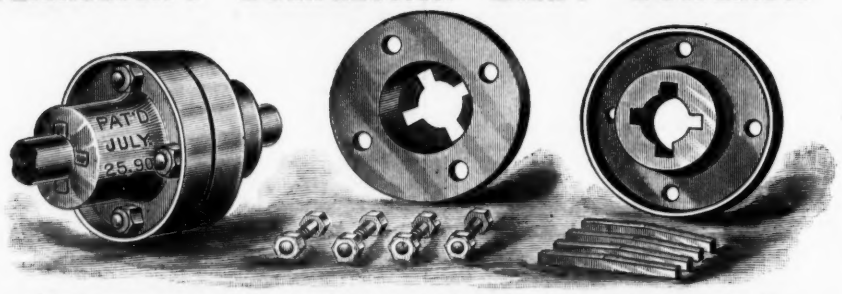

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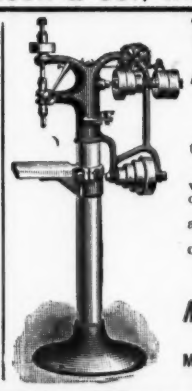

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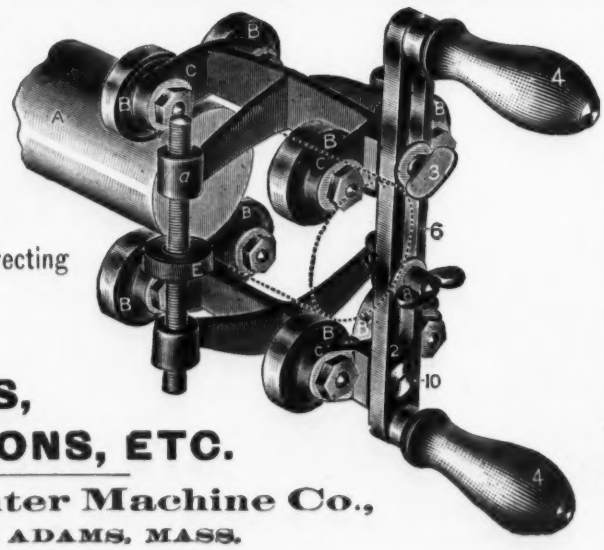

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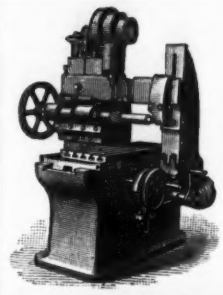

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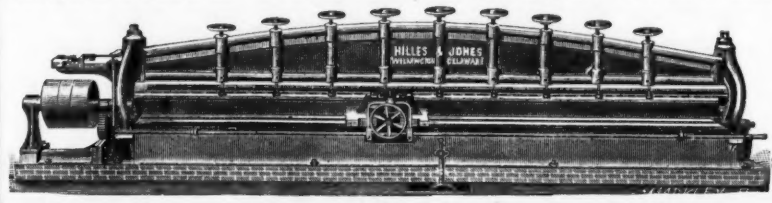

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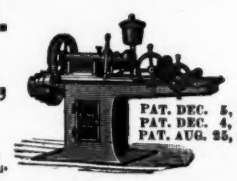

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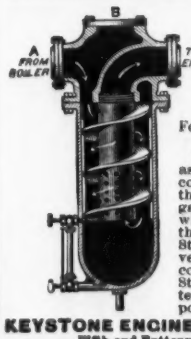

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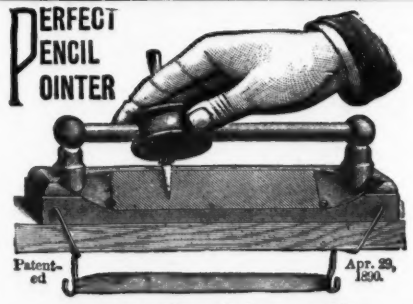

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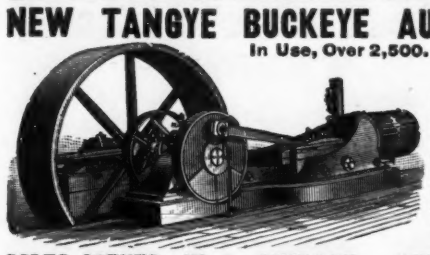

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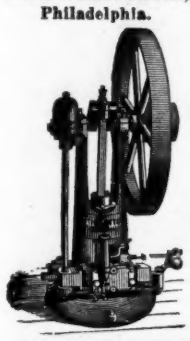

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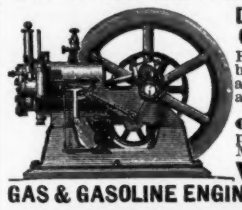

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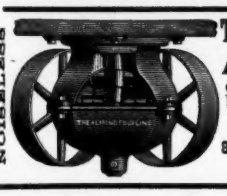

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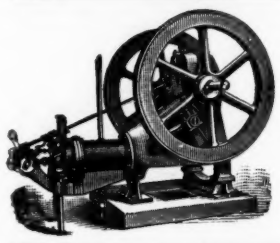

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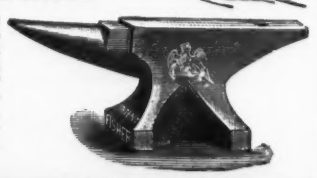

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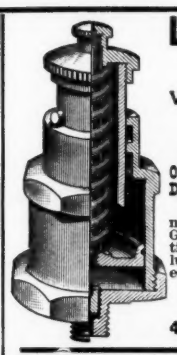

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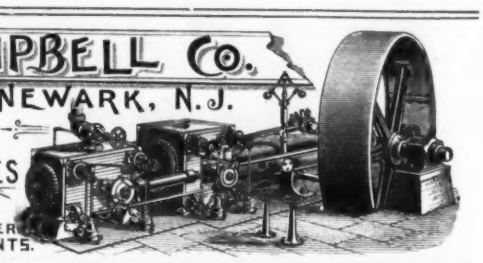

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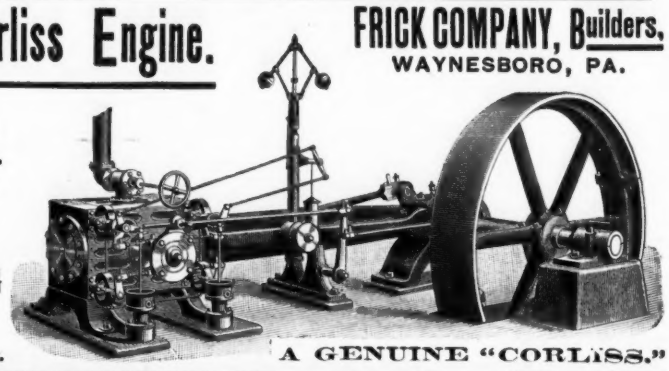

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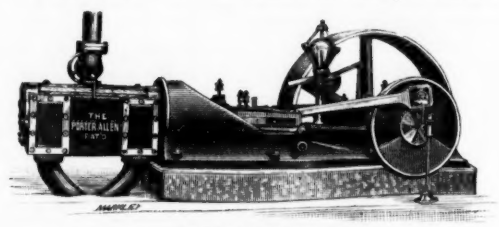

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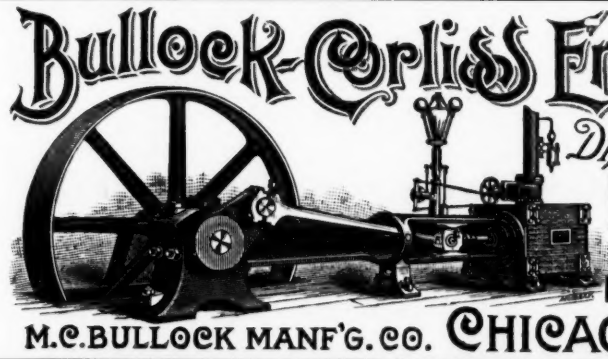

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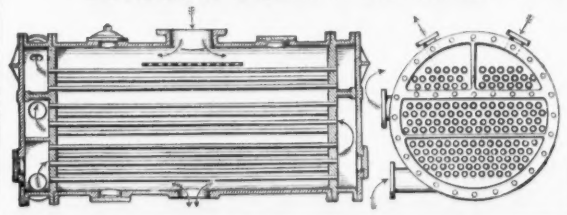

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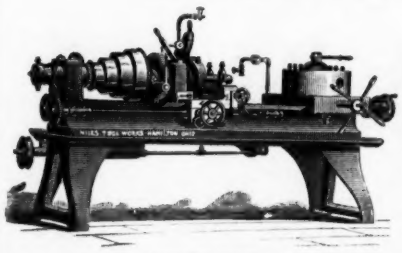

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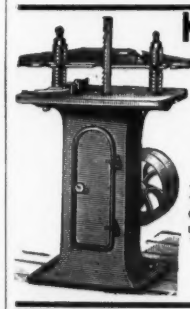

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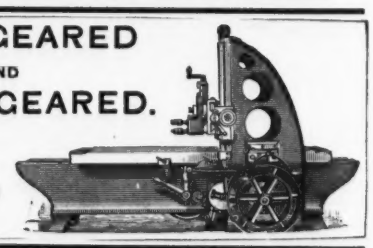

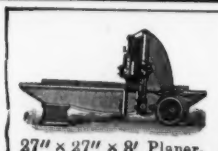

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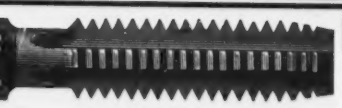

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